

WEST COAST SMOKE EXPOSURE TASK FORCE

Smoke Impacts: Frequently Asked Questions

This document brings together current research knowledge and practical experience and will be updated as new information becomes available. There is currently a lot of research being done on monitoring smoke in the vineyard and the impacts in the wine.

VINEYARD – GRAPE GROWERS

As a grape grower is there anything I can apply to protect my grapes from smoke damage?

Results from barrier spray trials have been inconclusive and contradictory. Effectiveness of barrier sprays is variable and perhaps related to differences in application timing and extent of coverage. Most barrier sprays materials should probably be washed off before harvest or after the smoke event. There is not currently a barrier spray being recommended.

Would washing my grapes in the vineyard help?

Washing grapes does not wash off smoke compounds (volatile phenols) as those are found in the skin. However, several smoke-related volatiles have been found in ash in lab analysis, and if left on the grapes has the potential to move into the grape berry. This needs further testing as research has not studied release of volatile compounds in vineyards. Fresh ash that goes through fermentation also has potential to increase smoke volatiles in the fermentation. It is possible that fresh ash could release these compounds into the fermenting must but research involving washing ash off the grapes is inconclusive. Some studies show rinsing ash off to be beneficial while another trial made it worse. The potential to increase mildew and rot and the time and expense involved are a consideration.

Any effort to wash grapes in the vineyard should be careful not to drive ash into grape bunches and washing should be focused, as much as possible, directly at the grape bunches and not surrounding leaves. Think about removing the leaves in the bunch zone before spraying. Washing away ash from varieties with tight clusters may be more difficult. Test the water spray pressure needed to ensure only washing of the outside of the cluster.

Can ash on grape berries be removed by simply washing the grapes?

Yes, not 100%, but a significant amount. Washing grapes at the UC Davis vineyard was tried using a pesticide application apparatus to spray water. A video of how this was done is [here](#).

I know there was some ash in the vineyard, but none is now visible on my grapes. Should I still wash them?

First, try a simple test. You can collect and place a few bunches in a container of water and evaluate the water for signs of any visible ash released from the bunches. If no ash is apparent, then perhaps the ash was removed (by the wind or another event) from the bunches, eliminating the need and benefit of washing in the vineyard or elsewhere.

Can ash on grapes contribute to smoke damage in wines?

Unfortunately, the role of ash in smoke exposure risk has not been studied extensively. Up to now there is only anecdotal evidence that ash may have an influence. Some winemakers believe

removing ash from their grapes was the difference between making a smoke impacted wine or not. Previously researchers were less concerned about the ash as it is carbon. However, preliminary investigations indicate fresh ash may be a source of volatile phenols (smoke exposure marker compounds). Ash collected from a vineyard at University of California, Davis was stored in a sealed container and the headspace above the ash was analyzed for the presence of volatile phenols. A significant number of volatile phenols were found. Volatile phenols have a half-life (break down over time) while ash (carbon) is very stable. Thus, the fresher the smoke, the more potential risk it poses. However, this has not yet been proven and is currently under investigation.

What should I know about pest control applications?

Common thought now is any pest control application containing adjuvants with 'sticker' or 'spreader' properties to enhance the effectiveness of the spray, during a smoke event, may promote greater smoke uptake by berries of damaging smoke compounds.

If leaves contribute to smoke uptake should I pull them off?

While leaves, like grapes, do absorb smoke exposure marker compounds (e.g., volatile phenols (VPs)), current research indicates limited movement of VPs from the leaves to the grapes. Leaves are important to maintain vine health so common thought is leaf removal may do more harm than good.

Will smoke exposure marker compounds (volatile phenols) disappear or decrease during ripening?

Volatile phenols (VPs) and their bound glycosides will not disappear during ripening. However, the ratio of free to bound VPs will decrease as ripening continues. The free VPs are glycosylated by enzymes present in the grapes over time. While there may be a decrease in free guaiacol, for example, there would be a corresponding increase in guaiacol glycosides. Both free and bound forms contribute to smoke damage in the final wine.

What is the best way to determine the risk of smoke damage?

Quantitative lab tests coupled with sensory analysis of wine produced from smoke exposed grapes is the best way to determine the risk posed by smoke exposed grapes to wine quality. Small-lot fermentations of a representative sample of grapes collected from a vineyard block can be used for sensory analysis.

- [Grape sampling protocol](#)
- [Micro-fermentation protocol](#)

All tasters used for sensory analysis should be tested, by having a smoke-impacted wine as a control, to ensure they are sensitive to smoke damage (20-25% of people are not). During a tasting session, tasters should use a 4 g/L sugar (or glucose) rinse in between samples and wait 90 seconds before tasting the next sample to minimize the carry-over effect from smoke damaged samples. A non-smoke impacted control wine should be used to ensure tasters are not biased and superfocusing, and to guard against carry-over between samples.

How does distance from a fire affect the risk of smoke damage?

Predicting grape smoke exposure risk based on topography and distance from the fire is very difficult. Many factors determine whether vineyards may be impacted and currently no proven models are available to reliably predict the risk of smoke damage to grapes, based on distance from fires, atmospheric conditions and length of smoke exposure event. This modeling is currently being studied as a key topic for research. Temperature of the fire, wind strength and direction, as well as topography play a role. Any smoke exposure in a vineyard may present a potential risk for smoke damage. However, the highest risk is fresh smoke. Meaning, that the risk of damage from smoke exposure is greater the closer you are to the fire and the risk of damage from smoke 24 hours or less in age is more potent than older smoke.

Is there a time when my grapes are not susceptible to smoke exposure?

New research indicates that grapes are susceptible at any stage of ripening after set. The degree of smoke impact may vary among different varieties, but this is not currently correlated with any grape physiological parameters. While grapes may be susceptible prior to veraison, it is likely that grapes

are more susceptible to smoke exposure after veraison. But the short answer is yes, grapes are susceptible immediately after set.

What should I ask my winery?

Have a dialogue about what the tolerance level is for smoke impact. You should be fully aware what the winery requires prior to harvest and the methods they will use to determine whether smoke damage has occurred. Ask them how they will test and have them provide details on sampling methods, testing methods, and interpretation of results. Ask to be included in the sensory evaluation process if they choose to do small-lot fermentations.

WINERY

Do you know anything about the solubility of the volatile phenols? If they are more soluble and extracted in the juice phase or in the alcohol phase?

Volatile phenols are very soluble and behave like anthocyanins. Yes, alcohol helps extract volatile phenols more quickly, but they are also soluble in water already. Processes or tools used to remove color from red skins, will also extract the volatile phenols and other components from skins, will increase the number of phenols in the wine.

Will smoke compounds (volatile phenols) continue to accumulate in berries over time? Instances where smoke has worked its way through the vine, and seen levels decrease in the fruit after enough time has passed?

Volatile phenols (VPs) present in the air can be absorbed by grapes, and leaves and potentially the rachis. The absorption of VPs will stop when the air does not contain high enough concentrations of VPs for absorption. The VPs in the grapes will start being glycosylated (bound) within hours of absorption and this process can go on for an extended period of time. So, a decline in free VPs in grapes over time may occur but will correlate with an increase in bound VPs. Both forms contribute to smoke impact, so it does not help you. When we see small increases in VP after there has been no more smoke impact, we think this may be due to vineyard variability. Berries from the same vine can contain vastly different quantities of VP.

Will whole cluster fermentations increase the risk of making smoke impacted wines?

There is the possibility that the rachis may also be a source of volatile phenols. For that reason, if you suspect smoke impact, it may be better to destem. However, this has not been specifically studied and is currently under investigation.

We are about to start small lot fermentations of clusters post smoke exposure; do we still need to turn in grape samples to the lab as well?

We recommend doing analysis on a sample from grapes that will be used for fermentation as well as analysis of a micro-fermentation of the finished wine ([micro-fermentation protocol](#)). Lab analysis of a grape sample or small-lot fermentation can be used to support a grower's crop insurance claim. USDA's Risk Management Agency has said if the analysis shows "any elevated number" then this information can support a loss claim. It's important to maintain and prove chain of custody. A lab analysis of commingled lots of wine, from different grape sources, is not valid for purposes of a crop insurance claim. Crop insurance carriers need a number for each block and variety and the ferments need to represent those grapes only. Also, results from a baseline grape sample small lot before smoke exposure or during a non-smoke year, can provide insight into whether lab results of grapes post exposure constitute "elevated" levels of smoke compounds. However, there are no clear, established thresholds by variety and wine style and researchers are trying to address these complex questions.

We always recommend collecting grape samples and freezing them in case of need for future use or claims.

Regarding using oak in your micro-ferments: As far as trials go, remember the moment a wine comes into contact with oak, free volatile phenols numbers will be affected by the oak contribution of volatile phenols, which are unpredictable and can impact your smoke analysis.

Are white wines generally less at risk than red wines?

The smoke compounds that affect wine quality reside in the skins and because of the way white wines are made, there may be less risk. However, since the matrix of flavor compounds in a white wine are less complex than red wine, the presence of smoke compounds in white wine may be more noticeable at lower levels than in red wine.

How do I minimize my risk during white wine fermentation/processing?

Anything done to reduce skin contact can help. Hand-picking, gentle pressing, no extraction enzymes. The press juice will have more smoke compounds than the free-run juice.

How do I minimize my risk during red wine fermentation/processing?

An unpublished study examined pinot noir wines made in several different styles and whole cluster fermentation produced the worst outcome, as far as smoke impact goes. UC Davis conducted preliminary testing, by researcher Anita Oberholster, Ph.D., and it suggested that whole cluster fermentation produce high levels of smoke damage in pinot noir (unpublished data). More testing to come to fully explore these issues, but currently, destemming is recommended. Sensory testing conducted by Elizabeth Tomasino at Oregon State University shows that more complex wines can mask the perception of smoke compounds and much work is ongoing to provide answers for winemaking techniques that can reduce smoke exposure while maintaining other desired wine quality parameters. Theoretically it makes sense that the rachis may absorb some volatile phenols, however, if it is hard and brown, will it release any? Currently, there is no definitive answer as there are many differences that alter the perception of smoke damage in wines. Dr. Oberholster would recommend erring on the side of caution and destemming fruit.

What does it mean when people say the smoke “keeps coming back”?

This idea of smoke flavor taste in wine reappearing refers to a phenomenon where winemaking tools or amelioration treatments were used and were thought to have successfully masked or removed the perception of smoke impact, but the perception of smoke impact returns over time. There are potential reasons why this occurs. As a wine ages, its fruity characteristics and wine body (phenolic content) can decrease, which contributes to the perception of smoke impact standing out more. Additionally, during aging, the slow hydrolysis of bound VPs may be released as free VPs which can change the expression of smoke impact. Also, in a solution such as wine, an equilibrium occurs where the volatile smoke phenols and bound smoke phenols reach a stable level. If the volatile free phenols are removed then the bound smoke phenols are released to their free form until the new equilibrium is reached.

When wine is treated by an amelioration technique such as fining, mostly free VPs are removed. Any sensory observation of reduced smoke impact can re-emerge if the new equilibrium is above smoke perception thresholds, although not always. Researchers speculate this is due to an equilibrium between free and bound VPs being re-established within the specific wine matrix, releasing more free VPs and thus bringing the smoky character back. However, we know that both free and bound volatile phenols contribute to smoke impact, but the ratio of the different components within a specific wine matrix may play a role in smoke impact expression.

Perception of compounds can also change due to the change of other compounds in the wine. For example, as a wine ages its fruity characteristics and wine body (phenolic content) can decrease, which contributes to the perception of smoke impact standing out more.

How do I involve my grape grower?

From an early stage, a winery should communicate the tolerance level for smoke and standards for the presence of smoke compounds. Early, timely and transparent communications are key. The winery should be specific about how grapes and wine may be assessed for smoke damage, and where feasible the grower should be involved in the sensory evaluation of wine. A winery's decision regarding the quality status of grapes and whether to accept grapes should be made with a clear understanding of the options and obligations provided for in the relevant grape contract.

CROP INSURANCE

What analysis does my crop insurance adjuster need for me to make a claim?

Guaiacol and 4-methylguaiacol markers from a certified independent lab, accredited lab, or other capable source (e.g., winery lab with resources to perform such test). Results should list the field location, the lab results, the lab name, and any accreditations indicating the lab is qualified to perform smoke exposure testing. Contact your individual insurance adjuster to understand if your lab can be qualified.

Analysis from a certified lab will be used to support a grower's crop insurance loss claim. USDA's Risk Management Agency (RMA) has not established specific threshold levels for the presence of smoke compounds in grapes or wine for purposes of determining smoke damage, except such lab results must support a finding of "elevated levels of guaiacol and 4-methylguaiacol."

A rejection letter or amendment to reduce pricing between winery and grower is required as documentation – listing damage from smoke as the cause for the rejection/reduction in price.

If the winery rejects the grapes, additional attempts to market the damaged grapes will be required. Contact your insurance adjuster to determine their specific requirements to prove additional attempts were made to market grapes. A salvage or bulk market rejection may also be required to supplement the initial winery rejection.

How do my results come back?

Lab analysis will deliver results for guaiacol (ug/L) and 4-methylguaiacol (ug/L). Most labs consider a value greater than 0.5 ug/kg (ppb) in grape samples or 1.0 ug/L (ppb) in wine as an elevated level for these compounds. Please look at the lab guidelines for what is considered elevated.

What if my internal lab tests down to 0.1ppb?

Per the rules of the crop insurance policy, there is no set numerical value for elevated levels of smoke. If a lab result comes back with a level below 0.5ppb, and this results in a rejection, work with your insurance company to verify the lab results are acceptable.

Do I need to collect a grape sample from my vineyard prior to harvest to support my crop insurance claim? If a winery rejects my grapes based on a small lot fermentation, is that acceptable? What if I freeze some clusters and analyze them later?

Grape samples tested for the presence of smoke compounds should be collected prior to harvest. Each variety and unit needs to be separately sampled and tested. The key in this step is to maintain the identity of where the tested fruit came from. Use photos with location identifiers to clearly document the location of where the grapes were pulled.

In addition to the lab test results, an analysis from a small-lot fermentation can support a grower's loss claim. A winery should provide a grower with laboratory test results, indicating elevated levels of smoke compounds, from wine produced in a small lot fermentation or if the winery's determination is based on a sensory analysis of the wine, then the winery should confirm in writing that the rejection is based on that sensory analysis.

It's a good idea to collect and store samples for later testing. Some insurance carriers are okay using test results from frozen or refrigerated samples; work closely with your specific claims adjuster and follow any guidelines they may have.

If the labs are backed-up, what if I don't get my results in time to make a claim? Is there leniency for lab delays?

Growers should file a notice of a loss claim with their agent when the presence of smoke is observed in the vineyard, even if you are weeks away from harvest. Growers are required to provide notice of a loss within 72 hours of when damage or loss is observed. It's good practice to open a loss claim immediately after smoke is observed in the area, regardless of the test results.

The USDA Risk Management Agency recognizes the considerable delays for industry operators to obtain lab results and they have attempted to make the lab testing process more attainable. In case-by-case scenarios, a lab test may not be needed. Again, work with your specific claims adjuster to determine if there is a work-around in this case.

Though most wineries will want the lab results prior to accepting the grapes, for crop insurance purposes the results do not need to be back prior to harvest, they just need to be taken prior to the harvest.

If grapes are harvested and the winery conditionally accepts with the intention of waiting for the tests, it's important that any test of grape samples (by varietal and unit) were collected prior to harvest. Any sample of wine made from your grapes must have been collected prior to the commingling of that wine with other lots of wine. The USDA Risk Management Agency requires a sample (of grapes or wine) used for a loss claim be identifiable and not collected after commingling. Samples collected after commingling cannot support a loss claim because those samples are not unique to the identity of grapes. It's fine for a winery to commingle lots of wine, provided a sample was collected for testing prior to the commingling.

What are the cut-off dates for California, Oregon and Washington to buy crop insurance and to follow up with a claim?

For new insureds, coverage begins on or after:

- February 1 in California or November 21 in all other states.

Crop insurance policy paperwork for new and renewing clients must be completed, signed, and submitted to your agent:

- January 31 in California or November 20 in all other states.

For carryover insureds coverage begins on the day immediately following the end of the insurance period for the previous crop year.

For all insureds, coverage ends with the earliest occurrence of one of the following:

- Total destruction of the crop;
- Harvest of the insured crop;
- Final adjustment of loss;
- Abandonment of the crop;
- November 10 in California, Idaho, Oregon and Washington.

Claims should be filed as soon as you suspect there could be damage. The policy states growers need to notify their agent within 72 hours of determining there could be an issue. There are no penalties for filing crop insurance claims, regardless of the outcome. The premium does not increase due to claims filed, and there is no monetary deductible for crop insurance.

Do I need to have crop insurance to be eligible for future disaster relief payments?

Typically, growers are not required to have crop insurance to qualify for disaster relief. However, the most recent USDA programs (Wildfire and Hurricane Indemnity Program Plus – WHIP+ and Emergency Relief Program – ERP) have elements that are specific to crop insurance.

Growers who have crop insurance can also file for a loss claim under ERP (formerly WHIP+). Thus, the combined payout from ERP and crop insurance is higher than it is for those growers without crop insurance who collected assistance under ERP. As a condition of payment eligibility under ERP, growers must obtain crop insurance, on the crop paid under ERP, for the first two available consecutive crop years. Crop insurance coverage level must be at a level of at least 60% coverage.

What sort of chain of custody-of-samples collected do I need to have?

Pictures when sampling the vineyard are great. Lot codes or contract ID codes to track the sample to the lab or micro ferment are also helpful. Discuss with the claim's adjuster any carrier specific requirements for tracking.

FROM THE USDA

The USDA has compiled FAQs on its website that can be viewed here:

<https://www.rma.usda.gov/en/News-Room/Frequently-Asked-Questions/Wildfires>

The most pressing matter for the insured is to contact their agent within 72 hours and collect samples for testing prior to harvest.

RISK ASSESSMENT

How do I determine if my grapes are smoke impacted?

It is important to obtain guaiacol and 4-methylguaiacol numbers from a third-party wine sample lab. However, research indicates other smoke compounds that may be present in grapes also contribute to perceptions of smoke affected wine. Right now, the best predictor of smoke exposure risk is an analysis that tests for the presence of 13 volatile phenols, 7 free and 6 bound forms. Although lab analysis of grapes with the extended panel of free and bound VPs of smoke exposed grapes can reveal useful information, such analysis alone may not always reliably predict the risk of smoke affected wines and a small-lot fermentation is necessary to see the full picture. A significant number of wine analyses may fall within a grey zone of uncertainty (low to medium risk). When uncertainty exists regarding the status of smoke exposed grapes or wine from those grapes, [nano-fermentations](#) or [micro-fermentations](#) allow for sensory analysis of the kind of wines that can be made from smoke exposed grapes.

See the video published by UC Davis on small scale fermentations: [How to do small-scale fermentations for the evaluation of grape smoke exposure risk.](#)

New research is being conducted on sensors in the vineyard that can accurately predict what phenols may be adsorbed into the grapes and environmental modeling that be able to show high and low risk vineyards and areas in a smoke event.

Are there any tools that the winemaker can use to reduce the risk of making smoke impacted wines?

With white wine the impact of smoke may be less due to more limited skin contact during winemaking, however it depends on the smoke exposure. If grapes/small scale fermentations reveal smoke impact, then winemaking should utilize very little skin contact, press fractions should be kept separate, and fining with activated charcoal of the juice can be used. [Please reference this technical review.](#) This process will strip the juice, but that may be compensated for, in varying degrees, through yeast selections, mannoproteins, oak selection, etc.

For similar reasons, making a rosé wine is an option for reds, although this is not always an economically viable option. Otherwise, make the best red wine possible and focus on amelioration options. For low impacted red grapes, using fruity yeast and oak additives that uplift fruit may be helpful, as well as methods to increase body through extensive extraction of color and other phenolics to help mask smoke impacts. This may be preferable to some smoke removal treatments which lack specificity and will remove some desired compounds along with problematic volatile phenols. Some residual sugar and good acid can help hide smoke impact as well, although this is based solely on anecdotal evidence and benchtop trails should be done. Treatments such as activated charcoal fining, reverse-osmosis and spinning cone remove a significant amount of free volatile phenols, but only a small amount of the bound. For a low (to medium) impacted wine, aggressive treatments may be effective, but there is a compromise on the overall impact to wine quality. Flash Detenté seems to play mostly a masking role.

What do air quality index (AQI) levels tell us about the risk of smoke damage?

The greatest risk of smoke damage in grapes occurs when fresh, dense smoke less than 24 hours old is present in a vineyard. Observing the direction of wind flows, relative to the source fire, may help determine how old the smoke may be, however due to the nature of smoke it can be hard to track its flow. Atmospheric scientists are working to develop better prediction methods. AQI levels at 2.5 micron are oriented toward protecting human health from the risks of ozone and ambient levels of particulate matter found in smoke. These AQI values have not been correlated, through research, with the presence of compounds that give rise to smoke damage in grapes. So, AQI levels are not a reliable predictor of smoke exposure risks in grapes.

Currently looking at an AQI level from www.airnow.gov can give you an idea of density of the particles. However, particles don't correlate to volatile phenol levels in the air, the compounds that impact grapes.

Are there any published threshold levels for lab analysis?

Research has not identified threshold levels as it is dependent on many factors including grape variety and the wine matrix (everything else present in the wine). This is another area that is currently being studied.

How do I perform a micro fermentation?

- [Micro-fermentations](#)
- [Nano-fermentations](#)
- [Video: Contains a step-by-step demonstration of small-scale fermentation protocol](#)

How do I evaluate my micro fermentation?

The recommended protocol is a useful tool for determining the kind of wine that can be made from smoke exposed grapes. However, in the case of white wines, the small-scale fermentation protocol entails prolonged skin contact which is a worst-case scenario. When a sensory evaluation is performed, evaluators should be aware that the protocol is a worst case scenario and is intended to eliminate as many false negatives as possible. However, you may choose to do a ferment more similar to how you would make your wine for another assessment (i.e. no white skin contact and no enzymes on red, if that is how you normally ferment). The small-scale fermentation protocol is merely a tool and should not be taken as definitive proof of potential wine quality. It is also recommended that any sensory analysis utilize a panel of tasters that understand what smoke compounds taste like to establish known viewpoints on levels.

Taste each sample at least twice within a short period of time. During a tasting session, tasters should use a 4 g/L sugar (or glucose) rinse in between samples and wait 90 seconds before tasting the next sample to minimize the carry-over effect from smoke damaged samples. Test that your evaluators are sensitive to smoke damage by screening, using both heavily smoke impacted and completely non-impacted wines as controls. Many people (approx. 25% of the population) are not sensitive to smoke damage.

What labs can I use for risk assessment and what analysis do I get?

A list of accredited labs has been compiled; if they are located out of the country, reach out to determine if there are import or customs issues based on your vineyard location. Most labs will analyze the free or bound primary indicators of smoke exposure impact (guaiacol and 4-methylguaiacol). Some also offer additional smoke volatile markers through an extended panel and/or offer smoke glycosylated markers for wine, which reports total bound smoke compounds. Such options may not be available during harvest due to time constraints.

Positive results don't necessarily correlate to damage because some of these compounds are present in grapes without smoke exposure. Without baseline data for a grape or wine variety, positive results may not correlate to smoke damage.

[View list of labs](#)

What other analysis can I look at beyond guaiacol and 4-methylguaiacol for indicators of smoke exposure impact?

Another option is a *smoke panel with volatile and glycosylated volatile markers extended panel* which will also give you cresols (sum and individual), phenol, 4-methylsyringol, and syringol and their bound glycoside markers. Bound markers should always be analyzed and taken into consideration. Check with your labs for turn-around times of the samples; this option may not be available during harvest due to time constraints.

Note: Some of these compounds are naturally present in grapes without smoke exposure, so without baseline data for a specific grape or wine variety, positive results don't necessarily correlate to damage.

This document was originally developed by Dr. Anita Oberholster (UC Davis) under the direction of West Coast Smoke Exposure Task Force (WCSETF) Research Committee chairs Alisa Jacobson and Melissa Hansen, with contributions from Elizabeth Tomasino (Oregon State University), Tom Collins (Washington State University) and WCSETF members. 6/20/24 (v.2)

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