



Heatwave simulator. Photo: Lukasz Tarkowski

Winegrape
Varieties

Pest &
Disease
Management

Collaboration in the face of climate change

Simone Madden-Grey explores research across France, Germany and Switzerland into how PIWI grape varieties respond to heat stress and disease as climate change puts greater pressure on growers worldwide.

The joint research initiative WiVitis concluded earlier this year with a symposium at the University of Basel. Researchers from France, Germany and Switzerland presented findings on the climate change resilience of PIWI varieties.

PIWIs are hybrid varieties primarily bred for powdery mildew, and downy mildew resistance. The project investigated the effects of heat stress on berry skin stability and on mildew resistance. Looking beyond mildew resistance, the

physical barriers to Botrytis infection were also examined.

A novel classification of epicuticular waxes

Researchers in Switzerland used a Cryo-Stereo-Electron-Microscope (Cryo-SEM) to generate 3D images of frozen berry skin samples. This allowed researchers to categorise skin surface structures.

Structural differences in epicuticular wax across grape varieties was understood prior to the project, but under WiVitis,

a novel classification using nine unique classes was developed. Varieties with the least textured wax structures were categorised Class 1, and those with the most textured structures, Class 9.

The surface classification was applied to a selection of white varieties including PIWIs, and traditional varieties, which functioned as reference varieties. While the majority of varieties analysed were categorised Class 5, it is interesting to note that only PIWIs occupied higher classes. The white PIWI, Souvignier Gris, was assigned the highest category, Class 9.

Sunburn resilience

At Julius Kühn-Institut (JKI), Germany, the effects of heat stress and sunburn were investigated, and the new classification system helped scientists correlate surface structure with sunburn resilience. To do this, a comparative analysis was undertaken comparing five PIWIs with two reference varieties. Five berries from each variety were placed into a single tray that was subjected to 45°C for two hours. This was repeated multiple times each growing season across multiple years. The large data generated were analysed using machine learning.

Researchers noted that berries sensitive to heat stress developed higher percentages of brown lesions. Of the varieties tested, Souvignier Gris – with wax structure classification, Class 9 – showed the highest resilience to heat stress. According to Dr Katja Herzog, group lead Digital Phenotyping, Institute for Grapevine Breeding at JKI, this correlates with the sunburn resilience of Souvignier Gris in the vineyard. Dr

I don't think it is just the thickness. I think the structure has a role to play in diffusing the sun intensity.

Dr Katja Herzog

Herzog attributes this to more than epicuticular wax thickness. "I don't think it is just the thickness. I think the structure has a role to play in diffusing the sun intensity". With a higher surface structure class, there are more nano structures to diffuse the intensity beyond the surface of the berry.

Botrytis susceptibility

PIWIs are primarily bred for powdery, and downy mildew resistance but a number of varieties also demonstrate Botrytis resistance. In order to examine the physical barriers to Botrytis infection in these varieties,

researchers used berry impedance and penetrometer measurements, together with the newly developed surface classification.

Berry impedance uses electrical pulses to test the elasticity of the grape berry skin, and by extension susceptibility to damage and infection. By recording berry impedance measurements of cuticle and wax thicknesses, and permeability for

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20,000 berries per season, Dr Herzog says, “We show that it’s [berry impedance] an indicator for Botrytis bunch rot, but also for the wax distribution. With this little sensor, it’s really easy to get information about the quality and the quantity of the cuticle and the waxes to compare different varieties”. This, she says, provides a valuable risk indication tool for Botrytis infection.

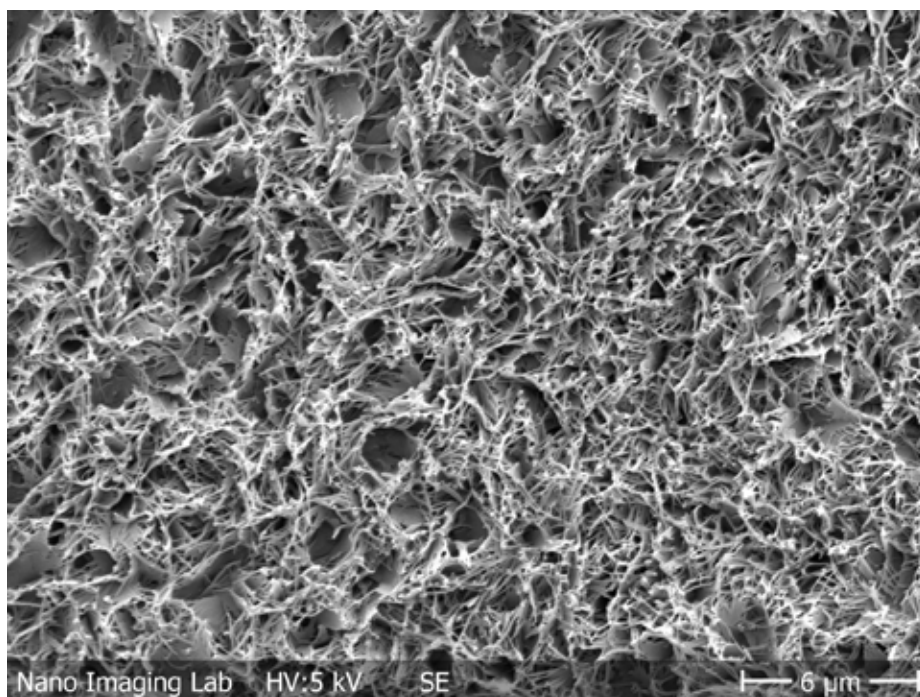
Additional testing of skin firmness and elasticity was conducted using a penetrometer. Commonly used in horticulture to assess fruit ripeness and crispness, penetrometers measure the force required to pierce fruit skin. At JKI, Dr Herzog said the team assessed 10,000 berries per growing season, comparing penetration resistance measurements for PIWI varieties with reference varieties.

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Dr Katja Herzog

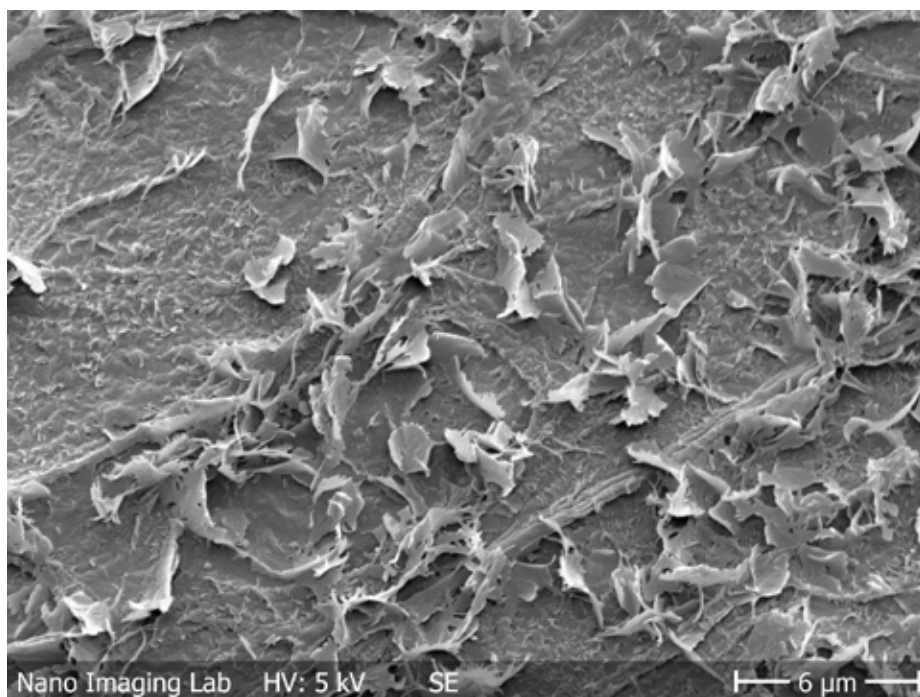
The role of the berry skin surface in Botrytis resistance was recognised prior to WiVitis. However, the distinction provided by the novel surface structure classification allowed scientists to correlate wax texture and berry impedance with Botrytis resistance. “Now we have different traits that we can easily phenotype to characterise our varieties, especially new varieties and breeding lines. We can say in general, with these berry skin characteristics, with these wax characteristics, there is a high risk for Botrytis or a lower risk”, says Dr Herzog.

In Switzerland at the University of Basel and the Research Institute for Organic



Microscopic surface image of Calardis Blanc, showing the grape variety's distinctive wax characteristics.

© Evi Bieler, Swiss Nanoscience Institute (SNI), Nano Imaging Lab, University of Basel, Switzerland



Microscopic surface image of Morio Muskat, showing the grape variety's distinctive wax characteristics.

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Agriculture (Forschungsinstitut für biologischen Landbau or FiBL), scientists were also examining thickness of berry skin layers and berry skin elasticity in PIWIs and traditional varieties. Of the findings, Dr Michael Riemann, Head of the on-station team Viticulture and Oenology FiBL, says that a clear difference in thickness of skin and elasticity was identified across the varieties examined.

Using Cryo-SEM to magnify different skin layers, researchers also confirmed a correlation between skin thickness and elasticity.

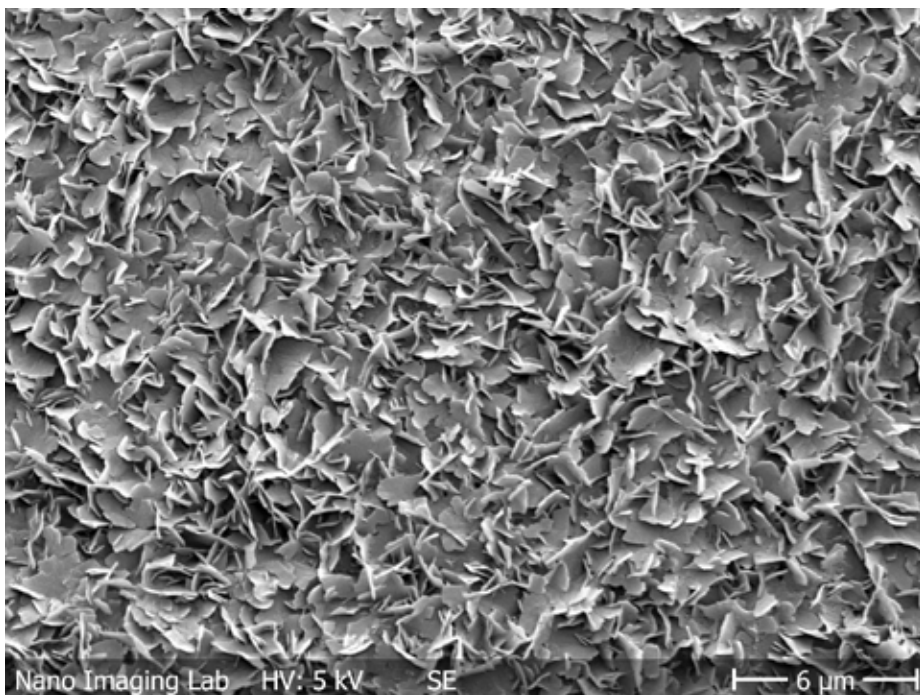
Results for Sauvignier Gris, known for high Botrytis resistance, showed a thicker, harder skin. This is evidenced by Cryo-SEM analysis revealing a substantial cuticle layer and large epidermal cells,

skin surface structures categorised as Class 9, and higher penetration resistance measurements.

While it is tempting to reduce prediction of Botrytis resistance to an assessment of skin thickness and elasticity, Dr Riemann notes that in the single berry assays they conducted, susceptibility to Botrytis did not always correlate with those physical parameters. “If the skin is more elastic”, he says, “it is probably more elastic to push through, but we don’t know if this would be the same for fungal hyphae”. Further research is needed to expand upon these findings and to better understand these differences.

Heatwave simulation platform

A simulation platform examining mildew resistance in the context of extreme heat stress has been developed by researcher Lukasz Tarkowski (Grapevine Health and Wine Quality Mixed Research Unit), and technician Frédéric Hammel, at the Grand Est-Colmar centre of the National Research Institute for Agriculture, Food and the Environment (INRAE), France.



Microscopic surface image of Sauvignon Blanc, showing the grape variety's distinctive wax characteristics.

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Seeking to replicate heat stress conditions outside the lab, Tarkowski and Hammel developed a prototype in 2024, using

sensors attached to vine leaves and infrared radiators piloted by a datalogger. The capability to accurately control

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Photo: Lukasz Tarkowski

temperature changes was then tested and refined. A year later the prototype was scaled to capacity for testing 60 plants arranged in successive rows as in a vineyard. Adjustable radiators were added to facilitate application according to vine height across growth phases, and a mobile roof was added to minimise impact from rain, wind, and UV exposure beyond the targeted parameter range.

To develop the experiment algorithm, Tarkowski said regional climate data spanning 15 years was used to define average temperatures for each month across the growing season. A heat wave temperature range spanning 20°C – 45°C was then added. The criteria, says Tarkowski, was to maintain a realistic differential throughout the simulation, mirroring the day-night variations.

Now able to control the temperature and having identified degree parameters across the growing season, five PIWI

Results, including molecular analysis of the effects of heat stress on mildew resistance, are due for publication in 2027.

varieties and one control variety were tested. Each variety underwent heat stress exposure for three days before leaf disc samples were taken and inoculated with powdery, and downy mildew. The rate of infection was then scored to create a scale of relative resistance. The results were analysed according to two distinct categories – how the physiology of each variety reacts to heat, and how their resistance to pathogens is impacted by heat.

Results, including molecular analysis of the effects of heat stress on mildew resistance, are due for publication in 2027. However, Tarkowski says that differences in resistance to both mildew pathogens were observed during their experiments. He is excited about the potential this technology has for the industry, and he says, “You have very robust validation”, if new varieties can be tested for a range of climatic events before market release.

Tangible outcomes of the project include research to support the development of new climate change resilient varieties, and materials for growers considering planting PIWIs. The WiVitis website contains details of the experiments conducted, grape varieties tested, and downloadable grape portraits complete with surface classifications. It is also the best way to stay informed as to the formal publication of research findings. **CW**

Practical, cost-effective solutions deliver for grapegrowers

Grapegrowers continue to face pressure to manage seasonal disease challenges efficiently and cost-effectively. ADAMA Australia's growing crop protection portfolio is designed to help growers protect vines from budburst through to harvest, while supporting yield, quality and practical resistance management.

Portfolio manager Robert Lomman said the portfolio had been shaped by years of working closely with viticulture agronomists and growers.

"We've worked in conjunction with viticulture agronomists and growers to specifically understand their issues and develop products that deliver practical value in the field," Lomman said.

One of the latest additions is **Folpan® 800 WG**, a cost-effective multi-site fungicide targeting downy mildew, powdery mildew and botrytis, with phomopsis also on the label.

Containing folpet, Folpan is a Group M04 broad-spectrum fungicide widely used globally. Its multi-site activity makes it a valuable resistance-management tool alongside single-site fungicides, while having minimal impact on beneficial insects.

Actavan Bio helps enhance the vine's natural defence processes while supporting berry skin elasticity and reducing berry split

Folpan can be used as a protectant cover spray in downy mildew and phomopsis preventative programs and offers growers an alternative supporting mode of action in botrytis and powdery mildew programs.

ADAMA Australia has also introduced **Actavan® Bio**, a biological fungicide offering a different approach to late-season botrytis management.

Containing glycine betaine, Actavan Bio helps enhance the vine's natural defence processes while supporting berry skin elasticity and reducing berry split, which can create infection sites for botrytis. It is designed to help suppress botrytis infection while supporting zero-residue programs for wine and table grapes.

Together, these additions complement ADAMA's broader grape portfolio, giving growers more flexibility to build practical crop protection programs around seasonal disease pressure, resistance management and crop quality.

For more information on ADAMA Australia's crop protection solutions for wine and table grapes, visit their **grape solutions webpage**, contact your local ADAMA representative, or speak with your agronomist or ag retailer. **CW**



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Folpan® 800 WG

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