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Late leaf removal raised peppery aroma compound in Tardif grapes by 33%

A study in southwest France found the timing of defoliation mattered in a hot, dry season, and blocking UV light cut rotundone formation.

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A study published this month in OENO One found that late leaf removal in Tardif grapes increased rotundone, the compound linked to peppery aromas in wine, by 33% during a warm and dry growing season, while blocking ultraviolet light reduced the compound’s

formation.

The research focused on Vitis vinifera L. cv. Tardif, a grape from southwest France that is known for producing high levels of rotundone and is being replanted after nearing disappearance. The work was led by Olivier Geffroy and co-authors and was published on July 1. It examined how grape exposure and UV radiation affected rotundone under field conditions in the 2022 vintage, a season marked by heat and dryness.

Rotundone is the main aroma compound behind pepper notes in grapes and wines. That makes it important for producers trying to preserve a recognizable style in red wines as hotter summers become more common. In practical terms, the findings suggest that vineyard canopy decisions may help sustain that peppery character even when heat and drought tend to suppress it.

The trial took place on a 0.4-hectare Tardif vineyard in the Saint-Mont appellation area of France. Researchers compared four treatments with an untreated control. One involved early defoliation in the fruiting zone in late June. Another used late defoliation in late July, shortly before mid-veraison. A third combined late defoliation with screens that blocked 99% of UV-A and UV-B radiation from mid-veraison to harvest. A fourth combined late defoliation with four daytime applications of modulated UV-C light between mid-veraison and harvest.

The researchers reported no meaningful difference between the control vines and those that underwent early defoliation. They said leaf regrowth likely reduced the intended increase in cluster exposure. By contrast, late defoliation produced a significant rise in rotundone concentration of 33%.

The UV-screen treatment then helped isolate the role of ultraviolet light. According to the paper, shielding bunches from UV-A and UV-B did not change air temperature in the bunch zone, but it did significantly reduce rotundone levels. That result points to UV radiation itself, rather than heat alone, as an important factor in the biosynthesis of the compound.

The daytime UV-C applications did not increase rotundone in the field trial. The authors said that may reflect the timing of treatment rather than a lack of effect from UV-C exposure itself. To explore that question, they ran a separate growth-chamber experiment using Syrah fruiting cuttings, another grape type known to produce rotundone. In that smaller test, three UV-C treatments applied at the beginning of the night appeared to produce a substantial increase in rotundone compared with untreated controls. The authors described those results as preliminary and said they need confirmation on a larger number of vines under field conditions.

The study was initially designed to run over three seasons, from 2021 through 2023, but only data from 2022 were retained. The researchers said an extreme spring frost in 2021 and severe downy mildew damage in 2023 prevented reliable data collection in those years.

That limitation matters because previous work on light exposure and rotundone has produced mixed results depending on grape variety and climate. Earlier studies cited by the authors found that temperatures above 25°C harmed rotundone accumulation, while irrigation could raise levels in grapes and wines. Research on fruit exposure had been less clear, with some vineyards showing declines after defoliation and others showing no effect or increases. The new study adds evidence that under warm conditions, carefully timed leaf removal can help if it is done late enough, and that ultraviolet radiation appears to play a direct role.

The paper also offers a more detailed explanation for why UV may matter. The authors noted that plants perceive UV through photoreceptors that trigger signaling pathways tied to stress responses. They also pointed to the possibility that reactive oxygen species may contribute to the oxidation steps involved in forming rotundone from its precursor, alpha-guaiene. The study did not prove that mechanism directly, but it framed UV as more than just a source of added exposure.

For growers and wineries, the findings could have practical value beyond academic interest. Rotundone is associated with a sensory marker that can define wine identity in varieties or local grapes known for spicy profiles. If warmer vintages continue to reduce those aromas, vineyard managers may look more closely at late defoliation and other

canopy strategies to protect style consistency without relying only on cellar adjustments.

The researchers conducted the field trial using randomized blocks with three replicates per treatment on units of 12 vines each. Harvest took place on October 3, and berry samples were analyzed for standard ripeness measures as well as rotundone concentration using gas chromatography-mass spectrometry methods described in detail in the paper.

The article was published as a short communication in cooperation with the 16th International Terroir Congress and the 3rd ClimWine Symposium, held this week in Angers, France. The authors said their results indicate that winegrowers cultivating Tardif can use late defoliation to enhance rotundone biosynthesis even during warm vintages, while any use of UV-C treatments will require further testing before it can be considered reliable under commercial vineyard conditions.