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Researchers test grape waste to fight vineyard disease

The Milan project uses dsRNA made from pomace and pruned canes to target downy mildew and gray mold.

Thursday, April 16, 2026

MILAN — A research project aimed at giving grapevines a new defense against downy mildew and gray mold closed this week at Vinitaly with a presentation of a strategy based on double-stranded RNA, or dsRNA, including molecules produced from winery byproducts such as grape pomace and pruned canes.

The project, called Grape4vine, was presented at the Veronafiere congress center in Verona by researchers from the University of Milan's Faculty of Agricultural and Food Sciences and Italy's Crea research council. It was funded by Fondazione Cariplo under a program focused on circular economy research and ran for 36 months, involving 25 researchers working in plant pathology, biology, microbiology, biotechnology, agricultural engineering and economics.

The work addresses two problems that have become central to modern viticulture: the large volume of waste generated by the wine sector and the environmental cost of conventional crop protection against diseases such as downy mildew and gray mold. The project's premise is that those byproducts can be turned into a resource for vineyard protection through RNA interference, a natural biological mechanism that can temporarily silence specific genes.

Silvia Laura Toffolatti of the University of Milan described the approach as one that "starts from the vine and returns to the vine" through circular economy principles. The system relies on dsRNA molecules that can trigger highly targeted gene silencing.

Researchers said the goal is to develop biodegradable formulations that leave no environmental residue.

A key part of the project focused on how to produce those molecules at scale. Anna Narduzzo of Crea and Ileana Vigentini of the University of Milan said the team tested grape canes and pomace as new substrates, alongside production methods using model plants such as Nicotiana benthamiana and microbial fermentation with yeasts including Saccharomyces cerevisiae. The researchers also examined whether the process could be expanded to industrial levels using technologies already employed for enzymes and biopharmaceuticals.

The team said this could lower costs while giving new value to agroindustrial waste that would otherwise be discarded. Although the project remains in development, its aim is to make dsRNA production viable on a large scale.

On the agronomic side, Walter Chitarra of Crea and Gabriella De Lorenzis of the University of Milan presented results on the main disease targets. For downy mildew, caused by Plasmopara viticola, they identified new susceptibility genes in the vine, especially from the LBD family. Silencing those genes with dsRNA led to a significant reduction in disease severity, according to data presented at the conference.

For gray mold, caused by Botrytis cinerea, the intervention targeted essential fungal genes in an effort to stop the pathogen’s development. The experimental results showed a notable reduction in disease incidence and strengthened the case for dsRNA as a new plant protection tool.

The project also included an environmental assessment. Jacopo Bacenetti of the University of Milan presented a life cycle analysis suggesting that replacing conventional pesticides with dsRNA-based formulations could significantly reduce environmental impacts because the molecules are biodegradable and leave no residues.

The next steps include industrial synthesis of dsRNA, formulation development, field trials and the start of the product registration process. Researchers said those stages will determine whether the technology can move from laboratory results to practical

use in vineyards.

Sara Borin, president of the Faculty of Agricultural and Food Sciences at the University of Milan, said innovation has long shaped Italian viticulture and argued for stronger technology transfer from research to business as growers face sustainability pressures and climate change. Barbara Ferro, chief executive of Veronafiere, also emphasized the value of closer ties between scientific research and industry.

Attilio Scienza, professor emeritus at the University of Milan, closed the event by underscoring the role of research and innovation in shaping the future of viticulture. A roundtable with companies, consortia and institutions then focused on how such tools might fit into the supply chain. Participants expressed growing interest in solutions that combine agronomic effectiveness with environmental and economic sustainability, while some companies called for faster public procedures to help promising projects reach vineyards sooner.