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Researchers identify first phage known to infect grapevine crown gall bacterium

Lab tests showed PAV1 suppressed more than 98% of bacterial growth; trials on grapevines have not begun

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Researchers have identified what they describe as the first known bacteriophage that infects Allorhizobium vitis, the bacterium tied to grapevine crown gall, a disease that can damage vines and lower vineyard productivity.

The finding, reported Tuesday, November 24 in Frontiers in Plant Science, points to a possible new biological control tool for a disease that has been difficult to manage. The virus, called PAV1, killed or sharply suppressed the target bacterium in laboratory tests and reduced disease symptoms in tomato plants used as a model system. The study did not test the treatment on grapevines in vineyards, so its practical value for commercial grape production remains unproven.

Bacteriophages, or phages, are viruses that infect bacteria. They have drawn growing interest in agriculture because they can target harmful bacteria without the broad effects associated with some chemical treatments. In this case, the researchers focused on Allorhizobium vitis, which is known for causing crown gall, a disease that produces tumor-like growths on plants. In grapevines, those growths can weaken the plant and affect long-term performance.

According to the study, PAV1 was the first phage described against A. vitis. The researchers said the phage reduced bacterial growth by more than 98% in laboratory conditions. A growth reduction analysis shown in the paper reported a global coefficient of 0.947, indicating strong overall suppression across the tested doses.

The paper also included early plant tests using tomato. In untreated control plants, disease incidence reached 83.3%. That fell to 46.7% when PAV1 was injected and to 50.0% when it was applied as a spray, according to the figures reported in the study. Images included in the paper showed smaller or fewer galls in treated plants than in infected untreated controls.

Those results suggest the phage may have enough biological activity to limit disease development in living plants, not just in petri dishes. But the gap between promising greenhouse or model-plant results and reliable vineyard use can be large. The authors framed the work as evidence of potential for grapevine crown gall biocontrol, not as a finished solution ready for growers.

The study also examined how stable the phage was under different conditions. Based on the reported results, PAV1 performed best around neutral pH and maintained high titers from -20 degrees Celsius to 40 degrees Celsius, with a rapid decline at higher temperatures. That kind of stability matters because any future farm use would depend

on whether the phage can remain active during storage, transport and field application.

The paper further analyzed the phage's genome and its place among related viruses. A phylogenetic comparison placed PAV1 within the Atuphduovirus group, according to the study's figures and metadata. Genome mapping in the paper showed a mix of genes linked to known phage functions and hypothetical proteins whose roles are still unclear.

Even with those encouraging findings, the study leaves several important questions unanswered. The work did not establish how well PAV1 would perform on actual grapevines, under changing weather conditions or in soils and plant tissues where bacterial populations may be uneven. It also did not show whether the bacterium could develop resistance to the phage over time, a common concern in phage-based control strategies. Another open issue is whether a single phage would be enough in the field or whether growers would need a cocktail of several phages to broaden activity and reduce the risk of resistance.

That caution is especially important because grapevine crown gall is a crop problem, not just a plant pathology question. Any future control method that helps protect vines could matter beyond agriculture and into the drinks business, since grapes are the raw material for wine and part of the economic base for many wine-producing regions. If a phage treatment can eventually be shown to work in vineyards, it could offer producers a more targeted biological option against a disease with worldwide impact. For now, that remains a possibility rather than a demonstrated outcome.

The study adds to a wider push to find biological alternatives for crop disease management as regulators, growers and consumers pay closer attention to chemical use and sustainability. Phages are often attractive in that context because they are highly specific. That same specificity, however, can also limit their use if a disease is caused by diverse strains that do not all respond to the same virus.

For grape growers, the research is best seen as an early but notable step. It identifies a previously unknown phage-host relationship and shows that the phage can strongly suppress A. vitis under controlled conditions. What it does not yet show is whether the approach can protect vines consistently in nurseries or vineyards, where infection pressure, temperature, moisture and plant wounds can all affect crown gall outbreaks.

The article’s authors said their results support further work on phage-based control of grapevine crown gall. That next stage would likely require tests on grapevines themselves, studies across more bacterial strains and longer-term trials to measure how durable the protection is under real production conditions. Until then, PAV1 stands as a promising lab discovery with possible agricultural and wine-sector relevance, but not yet as a proven treatment.