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Mediterranean vineyards adopt new strategies to combat climate change and preserve wine quality

Innovative soil management, organic amendments, and shading techniques help vineyards adapt to drought, heatwaves, and environmental challenges

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The Mediterranean wine sector is facing a critical moment as climate change intensifies, according to a recent report by the European consortium Climed-Fruit. This project, funded by the European Union, focuses on finding solutions for perennial crops such as grapevines, olive trees, almond trees, and cherry trees to adapt and survive in increasingly extreme environmental conditions across the Mediterranean basin. Since 2020, Climed-Fruit has brought together research centers, universities, agricultural cooperatives, wineries, and government agencies from countries including Spain, France, and Italy. Their goal has been to test innovative agricultural management practices in real-world farms.

The findings of their study, titled "Adaptation to climate change and mitigation for perennial crops in Mediterranean area," provide a concrete roadmap for the future of European vineyards. The research starts from a clear fact: the Mediterranean region is warming faster than the global average. It faces recurring droughts and soil erosion that threaten both wine production and quality. Climed-Fruit’s work focuses on soil management and carbon storage, improving resilience to heatwaves and droughts, and adopting sustainable farming systems that allow vineyards to survive under drier and more variable conditions.

The study highlights that agriculture in the region contributes about 30% of total human-caused greenhouse gas emissions. Reversing soil degradation has become a European priority since the Soil Pact was approved by the European Commission in 2021. Researchers propose a combination of climate- and territory-adapted techniques, supported by pilot experiences in actual vineyards and orchards.

One key practice is the use of compost and other organic fertilizers made from pruning waste and plant residues. These amendments steadily increase organic carbon content in soils. Trials in vineyards in Valencia and southern France have shown that regular compost use can reduce external inputs by up to 70% while maintaining grape quality during drought years. Compost and its derivative, compost tea, not only improve soil structure but also boost biological activity and help plants withstand water stress by improving water retention during critical periods.

For table grape varieties like Crimson Seedless and Sofia, applying these organic amendments increased sugar concentration and improved vine water status. Climed-Fruit also studied mulching—covering soil with organic materials such as wood chips, shredded prunings, tree bark, or even oyster shells. Over three years, the VITIMULCH project tested different mulching types in southern French vineyards. Results showed soil organic matter increased by up to 2.5%, beneficial organisms like earthworms became more abundant, and moisture lasted longer even during dry summers. Mulching also protects against erosion, reduces herbicide use, and supports circular economy practices on farms.

Making full use of pruning waste is another key strategy. Instead of burning or removing these materials—a common past practice—Climed-Fruit recommends shredding and spreading them between vineyard rows. This creates a protective layer that reduces evaporation, adds carbon to the soil, and provides shelter for beneficial fauna. When combined with mulching, this approach can increase soil organic carbon by up to 73% in vineyards according to consortium data. These methods not only cut emissions but also help create a more balanced and resilient vineyard ecosystem.

The report also addresses winery waste management. The WETWINE project within Climed-Fruit has developed technologies to turn wastewater treatment sludge into safe organic fertilizers for vineyards through anaerobic digestion and artificial wetland treatment. While these fertilizers have less impact on soil than nutrient-rich amendments like compost or biochar, they contribute to overall sustainability by closing nutrient cycles and reducing reliance on commercial fertilizers.

Biochar—produced by pyrolyzing plant residues—is another solution highlighted by Climed-Fruit. Trials in Spain and Italy show that regular biochar application increases soil organic matter and improves water availability during dry months. Vines respond especially well to biochar in years with little rainfall because it helps retain water and strengthens plant resilience. The European Union has already authorized biochar use in organic farming, paving the way for wider adoption in Mediterranean vineyards.

Reducing tillage and managing cover crops are also recommended strategies. Permanent ground cover—either spontaneous or sown with adapted species like grasses or legumes—limits erosion, improves soil structure and fertility, and stores carbon stably over time. Trials in Languedoc (France), Valencia (Spain), and Tuscany (Italy) have shown that introducing self-seeding clovers or grass mixes helps balance vine growth with competition for water and nutrients. Winter sheep grazing—a traditional practice—is being revived as an efficient way to maintain cover crops while adding organic matter without herbicides.

To address rising temperatures and more frequent heatwaves, Climed-Fruit recommends installing shade nets over vines—a technique already adopted in some Spanish and Italian vineyards. Shade nets reduce sunburn risk on grapes, delay ripening by up to five days, and improve key quality parameters such as acidity, aroma accumulation, or tannin content—crucial for wine quality in warm climates. Trials in sparkling wine vineyards in northern Italy show that choosing the right color and shading level can modulate ripening times and protect grapes during critical summer weeks.

Foliar application of kaolin—a white mineral powder—is another validated recommendation. Kaolin reflects part of the sun’s radiation, lowers leaf and cluster temperatures, and protects plants from heat stress. In Marselan grape vineyards near Valencia, kaolin improved wine color and aroma profile while helping preserve grape integrity during extreme heat events—key for maintaining quality during hot seasons.

Agroforestry practices such as planting hedgerows are mentioned as tools for additional carbon storage and soil conservation. Climed-Fruit proposes planting perimeter hedges or shrubs between vineyard rows to boost biodiversity, fix carbon, and reduce wind erosion. Pilot experiences on 30-hectare plots suggest these hedges can sequester over 600 kilograms of CO_2 equivalent per hectare per year if properly planned.

Climed-Fruit concludes that adapting Mediterranean vineyards to climate change requires large-scale adoption of these practices. The project has developed simulation tools so growers can assess how different strategies affect soil carbon levels and long-term productivity. Involvement from cooperatives, wineries, and public agencies is seen

as essential for speeding up implementation across the sector.

The coordinated work led by Climed-Fruit shows that transitioning toward resilient viticulture is possible when innovation is combined with local knowledge and collaboration among all stakeholders. Embracing composting, mulching, biochar use, cover crops, shading systems, circular waste management practices—and integrating green infrastructure—offers a realistic path forward for Mediterranean vineyards facing tougher climate conditions ahead.