CLIMED-FRUIT

Extended Practice Abstract Nº 21

Novel solutions for termination of winter cover crops in the vineyard, aimed at increasing drought resilience under Mediterranean conditions

Challenge

Mediterranean vineyards face increasing drought stress due to climate change, with meteorological drought projected to increase by 50% by the end of the 21st century. Traditional irrigation approaches are becoming unsustainable due to water scarcity and limited access to water resources, particularly affecting the main EU wine-producing countries (Italy, France, Spain), which account for 67% of global wine production.

Solution

The LIFE DRIVE project developed and validated three innovative winter cover crop termination techniques:

1. **Under-row mulching**: Mechanically slashing and piling biomass under the vine row to reduce direct evaporation and maintain soil moisture
2. **Crimper rolling**: Rolling vegetation down to create a protective 'coating' on the soil surface, reducing evaporation while limiting native vegetation resumption
3. **Green manuring**: Incorporating shredded biomass into soil using a rotary harrow to improve soil structure and water retention

Different seed mixtures with varying floristic composition and C:N ratios were tested, including cereal-based and legume-based cover crops, each providing distinct benefits for grape composition.

Benefits

These techniques help improve water retention, reduce erosion and support carbon storage in the soil. They also enhance pollinator activity and help grapevines use water more efficiently during summer droughts, leading to better grape quality. From the social perspective, they raise awareness about the essential role farmers play in protecting vineyard ecosystems and promote knowledge sharing within the farming community.

Applicability box

Theme

Improving resilience of crops facing climatic hazards

Innovative practices for water stress management and dry farming

Context

Mediterranean vineyard systems facing water scarcity and drought stress, particularly suitable for regions with limited irrigation water access

Application time

All year (cover crop planting after harvest; termination in late spring)

Required implementation time

One growing season for full implementation (6–8 months from cover crop establishment to termination)

Period of impact

Multi-seasonal benefits with cumulative effects over 2–3 years of continuous application

Equipment

- Seeding equipment for cover crop establishment
- Crimper roller for rolling termination
- Rotary harrow for green manuring
- Mechanical slasher for sub-row mulching
- Standard vineyard maintenance equipment

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Practical recommendation

For optimal results, select cover crop seed mixtures based on specific vineyard goals: use cereal-based mixtures for higher grape sugar content or legume-based mixtures for enhanced acidity and yeast assimilable nitrogen (YAN) levels. Implement termination techniques in late spring when biomass production is maximised but before significant water competition occurs. Under-row mulching is recommended for vineyards that prioritise water conservation, while green manuring suits soils that require organic matter improvement. Monitor seasonal weather patterns as they significantly impact biomass production and water-use efficiency. Combine practices with precision irrigation management for maximum drought resilience benefits.

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Simplified cost/benefit analysis

Winter cover crops in the vineyard

Introduction – presentation of ex-ante and ex-post situation

Ex-ante (before): Traditional tillage practices with high fuel consumption (52 L/ha), limited water retention and vulnerability to drought stress

Ex-post (after): Implementation of innovative cover crop termination techniques resulting in reduced fuel consumption (40 L/ha), 10% improved water storage, enhanced ecosystem services and long-term economic benefits despite higher initial costs

Economical costs and benefits

Legend

Estimated indicator

Measured indicator

The implementation of cover crop strategies can involve initial management costs, but these are balanced by long-term economic benefits linked to improved ecosystem services. The project explored financial tools to support adoption, such as favourable interest rates for sustainable farms, parametric insurance schemes and value-added certification or trademarks. These instruments help farmers monetise the environmental benefits of their practices. Additionally, increased collaboration and knowledge exchange among stakeholders reinforce the recognition of farmers' roles in preserving vineyard ecosystems, potentially opening new market and funding opportunities.

	Ex-ante	Ex-post	
Variable costs (€/ha sloping vineyards)		*First year*	*Following years*
Tillage/soil preparation	100–130	60–80	
Seed purchase		80–250	
Seeding		80–90	
Mulching**, mowing, termination**		50–100	50–100
TOTAL	**100–130**	**270–520**	**50–100**
		plus 200–400%	*minus 25–50%*
COMPARISON	Global increase of the cost:		
Economic benefits	Annual vegetation cover entails more than twice the cost of a single tilling operation. In the case of multi-year grassing, the cost of annual management (without seeding) is significantly lower than tillage. The costs vary if cover cropping is applied to alternate rows only.		

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Environmental costs and benefits

Energy	Indicator improvement of 25%:

Fuel consumption is reduced when alternating green manure and tillage (one row out of two), compared to full tillage. For example, annual fuel use can decrease from about 52 L/ha to 40 L/ha, representing an improvement of around 25% (source: GES&VIT, IFV). In addition, green manure contributes to nitrogen fixation, returning 10–20 kg N/ha/year depending on the legume species used. This reduces the need for external nitrogen inputs and the associated energy required to produce and apply them.

Fuel Consumption	**Ex-ante**	**Ex-post**
Rotary arrow (soil labour)	13 L/ha/pass all rows: total 52 L	6 L/ha/pass one row in two: total 25 L
Seeding	-	5 L/ha
Mulching	-	6.5 L/ha
Mowing	-	3 L/ha
Total	52 L	40 L

Water	Water storage improvement estimation of 10%:

Other interesting data (estimations) related to this indicator:
Water footprint reduction: Substantial decreases in water scarcity indicators (66%), aquatic acidification (21%) and eutrophication (56%)

Soil	Erosion protection improvement +50%:

Other interesting data (estimation) related to this indicator:
Carbon sequestration: +10%

Air	No data in the framework of the project
Biodiversity	Pollination enhancement estimation of 20%:

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LIFE DRIVE - Drought Resilience Improvement in Vineyard Ecosystems

Short description of the OG

The LIFE DRIVE project was a comprehensive two-year initiative (2021–2023) focused on developing and validating innovative soil and canopy management techniques to improve water resilience in vineyard ecosystems. Implemented across six demonstration vineyards in northwest Italy, the project tested multiple winter cover crop termination strategies to combat increasing climate change effects on Mediterranean viticulture.

Benefits

Improved vineyard resilience to climate change through optimised soil and cover management. Enhanced water retention, reduced erosion and more efficient use of water resources, supporting sustainable grape production in Mediterranean conditions.

Stage of implementation

The two-year project has been completed, testing and demonstrating the different practices in the field.

Applicability box

Theme

Adaptive management, climate change adaptation, water-use efficiency

Duration

2 years (*01/01/2021–31/12/2023*)

Partners involved

Università degli Studi di Piacenza (lead institution), Università di Milano, Università di Pavia, ART-ER. Farms involved: 6 demonstration vineyards in northwest Italy (Cantina Sociale di Vicobarone and Terre d'Oltrepò wineries).

Budget

Total budget: €1,659,215

EU contribution: €898,829

Main achieved or expected results

- ✓ Confirmed water storage improvements across demonstration sites
- ✓ Vineyard performance: Maintained positive leaf water potential and photosynthetic rates during drought periods
- ✓ Grape quality optimisation: Demonstrated effects on grape composition including sugar levels, acidity and YAN content based on cover crop species selection
- ✓ Business model development: Identified financial mechanisms and market opportunities for sustainable vineyard practices
- ✓ Validated three distinct cover crop termination techniques suitable for different vineyard conditions
- ✓ Enhanced ecosystem services delivery including carbon sequestration, biodiversity support and soil protection
- ✓ Developed practical recommendations for sustainable vineyard management under climate change
- ✓ Created replicable methodologies for water-efficient viticulture practices

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Existing materials

Project website https://www.drive-life.it/

Layman's report

(EN) https://www.drive-life.it/wp-content/uploads/2023/11/DRIVE_LaymanReport_EN-1.pdf

(IT) https://www.drive-life.it/wp-content/uploads/2023/11/DRIVE_LaymanReport_IT-1.pdf

Additional resources: Technical guidelines, best practice manuals and implementation protocols available through project website

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