

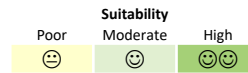
Critical issues and suggestions



Scarce cover crop growing

- Cover crop cultivation in degraded areas are often difficult as a result of very low fertility, high calcium carbonate content, and/or high stoniness.
- In small highly degraded areas, cover crop seeds shall be mixed with manure or compost, soil and water, and then manually sown to increase germination.
- During exceptional dry winters and springs, cover crops might compete with grapevines. If frost occurs, they can also increase damages. In these cases, it is better to anticipate the mowing and green manuring to April.
- When soil functionality degradation involves deep soil horizons (> 50-60 cm), the proposed organic treatments cannot solve the problem (at least in the short term).
- Additional organic strategies, such as cultivation of deeper soil horizons and /or improved soil addition shall be developed and tested in the future.

Suitability of restoration practices in different soil conditions



	Excesses			Deficiency	
	Stoniness	Calcium carbonate	Erosion	Organic matter	Fertility
Compost	😄😄	😄😄	☹️	😄😄	😄😄
Green manure	☹️	😊	😊	😊	😊
Dry mulching	☹️	😊	😄😄	😊	😊

Guidelines for soil restoration techniques in vineyards

ReSolVe project: Restoring optimal Soil functionality in degraded areas within organic Vineyards

The project aimed to restore soil functionality in vineyards that show areas with reduced vine growth, disease resistance, grape yield and quality.

The cause of degradation can be:

- improper land preparation,
- excessive erosion and/or compaction,
- loss of soil organic matter and nutrients.

The project individuated in five European country (Italy, France, Spain, Slovenia, and Turkey) the main causes of the soil functionality loss and tested different organic recovering methods.



Area with reduced vine performances



Loss of topsoil by water erosion

Selected strategies to recover soil functionality in degraded areas

1) Compost fertilization

Compost is a general term to indicate a mixture of various decaying organic substances, manure and other vegetable wastes.

In viticulture, prunings, grape stalks and marcs can be used to produce compost on farm.

The organic material must be arranged in windrow or long piles, left moist and well-aired for at least one year, until organic matter is nearly completely decomposed by micro-organisms.

Good quality compost (C/N about 10) can be spread in autumn or spring, when the soil is not too wet, **incorporated along interrows by chisel or tiller.**

At least 40/50 tons per hectare every year until the required fertility is reached.



A) Composting site;
B) Compost burying by tiller

2) Green manure

Green manure is a mixture of cover crops that are ploughed into the soil to fertilize it. Vineyard cover crops are usually sown in autumn and then incorporated into the soil in late spring, during the flowering.

A mix of different botanic families (legumes + cereals + crucifers) is recommended to increase biomass and cover crop benefits.

A mix of legumes and cereals, varying according to climate and soil type, was tested in each vineyard of the project.



Green manure in spring before ploughing



Crop suitability for green manure, and their expected effect on soil

Annual crops for green manure	Seeds amount (Kg/ha)	Nitrogen increasing	Stable organic matter increasing	Topsoil structure improvement	Pores and drainage increasing	Biocidal properties
Field bean	80-100	↑↑	↔	↑	↑	↔
Vetches	70-80	↑↑	↑	↑	↑	↔
Cereals (Barley, Oats, Rye, etc.)	40-50	↔	↑↑	↑↑	↔	↔
Brassicaceae (Mustards, Horseradish, etc.)	15-20	↔	↑↑	↑	↑↑	↑↑



Cover crops in spring (A) and summer after mulching (B)

3) Dry mulching with perennial legumes

Perennial legumes can be used to permanently cover the vineyard inter-rows of degraded areas, protecting soil from surface erosion, and increasing fertility.

Cover crops are usually sown in autumn, mowed in late spring and left on the surface, forming a dry mulch during the summer period.

The dry mulch reduces water evaporation and increases organic matter content. Cover crops have to be reseeded after 3-4 years. Seed amount: 15-20 kg/ha (low degradation), 20-30 kg/ha (high degradation).

Crop suitability for permanent grass cover, their expected effect on soil, and agronomic features

Perennial crops for dry mulching	Erosion protection	Biomass	Nitrogen supply	Cover crop stability	Water competition
Clovers (<i>Trifolium squarrosum</i> , <i>T. incarnatum</i>)	↑	↑↑	↑↑	↑	↔
Creeping clovers (<i>T. subterraneum</i> , <i>T. michelianum</i>)	↑↑	↑	↑↑	↑↑	↔
Alfalfa (<i>Medicago sativa</i>)	↑	↑↑	↑↑	↑↑	↓
Grass species (Ryegrass, Fescue, Poa, etc.)	↑↑	↑	↓	↑	↓

The main effects surveyed

- ✓ After two years, the compost supply seems to be the most rapid and clearly observable treatment to improve grapevine health and vigour.
- ✓ Compost is also efficient in increasing soil nitrogen and organic matter content.
- ✓ However, the reduction of erosion risk is lower than using green manure and dry mulching.
- ✓ Dry mulching tends to increase organic matter and biodiversity more than green manure, possibly because of the no tillage.

Effects of organic strategies in degraded areas of the vineyards after 2 years of application

Strategy	Grapevine				Soil				
	Vigour	Leaves chlorophyll	Water stress	Grape yield	Erosion protection	Organic carbon	Nitrogen	Biological activity	Biodiversity
Compost	↑	↑↑	↔	↑	↑	↑↑	↑↑	↑	↑
Green manure	↔	↑	↔	↔	↑↑	↑	↑	↑	↑
Dry mulching	↔	↔	↔	↔	↑↑	↑↑	↑	↑↑	↑