# MACMHER: alternative methods to control weeds in organic vineyards


## Summary

The control of weeds is one of the major challenges facing organic farming. Their presence may lead, depending on the crop, to losses in excess of 15% (Oerke et al.,2006). Organic vines are one of the crops that need to manage the various challenges posed by pest and disease control, in addition to dealing with the damage caused by weeds and the costs incurred by their removal. Tillage practices have always constituted the commonest strategy for the removal of weeds (ESYRCE, 2011; MAGRAMA, 2013). Tillage and its associated work may cost approximately €50 per hectare, in addition to the costs of its environmental impact, such as the emission of $CO_2$. The periodicity of such actions may be very high, resulting in significant costs from both the financial and environmental perspectives.

Preliminary studies, mainly centring on the performance of a life-cycle assessment (LCA), on vines indicate that tillage is the technique that has the best carbon footprint (Sanz Requena et al., 2008). The high risk of soil erosion that may take place at different farms should also be considered. Using tillage for the management of weeds in the rows of vines at vineyards that employ organic production techniques is an efficient process. However, the removal of the plant life that grows under the rows of vines is a complicated task due to the risk of damage it poses to the vines. It is in this area where the main competition for water and nutrients takes place, which means that in some cases, depending on the type of weeds involved, tillage may be not only costly, but also inefficient. The use of specific under-vine weeders has enabled progress to be made in weed control, Particularly those with hydraulic springs, which enable the soil to be turned over under the vines and then removed. However, in some cases the hardness of the ground means that these weeding machines may have to work more intensely, running the risk of damaging the vines. At the same time, the ability to remove weeds under the vines cannot be fully guaranteed as it depends on the floristic composition, architecture and plant life structure of the species to be removed. In recent years, certain species of hardy and quick-growing weeds, such as *Conyza bonariensis*, *Conyza sumatrensis* and *Aster squamatus*, have been identified at fruit orchards and vineyards in our country. These species are considered to pose the biggest threat to various strategic production sectors in Spain (Jiménez-Díaz et al., 2017).

One of the possible alternatives to the use of under-vine weeders, especially given the proliferation of infestations of the aforementioned species, is the use of mulch, particularly organic mulch made up of a variety of plant materials. In general, organic mulch inhibits the growth of weeds thanks to both its physical effects (light interception and temperature) and its chemical effects (the possible release of allelopathic substances) (Oliveira et al., 2014). Other studies (Dhima et al., 2006) have found that organic mulch based on winter cereals (wheat, barley) reduces the emergence of certain weeds by 87%, proving the allelopathic effect of extracts of these cereals on the germination and development of weeds. It has also been observed that the effect of mulch not only reduces the population of weeds in vines, but also improves a number of soil quality indicators, such as humidity and structure (Zribi et al., 2011; DeVetter et al., 2015). Other mulches, like those based on pine needles, have also been found to improve the quality of soil, reducing salinity by as much as 62% (Zhang et al., 2008). However, there are no studies that assess the possible collateral effects on the vines with a view to avoiding unsuitable options.

In this study, the use of different types of bioherbicides that burn or dry out the weeds is also proposed.

Their efficacy, however, depends on the dose and on the type and development stage of the weeds (Chinery, 2002). The implementation of this alternative, however, is hindered by a lack of the necessary experimental knowledge and technological advances. Using alternatives to traditional mechanical methods at vineyards to control weeds may lead to a number of positive outcomes.

## Objectives

The general objective of the study is to assess the efficacy of alternative methods to control weeds at organic vineyards. The study focuses on the control of weed species that develop under the vines (where it is most difficult to take action) and on the assessment of alternatives to the use of under-vine weeding machines. It particularly centres on weed species whose proliferation is becoming more widespread and those with a high capacity for dispersion and infestation. *Conyza bonariensis* and *Aster squamatus* are the target species due to their current proliferation in vineyards. The objective of establishing alternative methods to control these species is based on the proven efficacy of the use of various mulches and new bioherbicides with other crops at different locations.

The specific objectives that are proposed are as follows:
- Assess the effect of different mulches on the emergence of the selected target species and of any others that may develop under the vines. The selected mulches will be based on straw from different plants and pine needles.
- Determine the possible allelopathic effects of extracts of plant material used as mulch as a result of inhibiting the growth of the target species.
- Assess the effect of various bioherbicides (in different doses and in different phenological stages) on the aforementioned target weed species.
- Compare the efficacy of control methods based on mulches or bioherbicides with that achieved with the traditional use of under-vine weeders.
- Estimate the possible inhibiting effects on the robustness and yield of the vines arising from the use of mulches and bioherbicides.
- Conduct a financial and viability assessment of the implementation of the tested treatments.

## Description of initiatives outlined in the project

This project implements two new strategies for organic vineyards: the use of mulches and the application of natural active herbicides. The use of mulch under the vines may be a positive option not only due to its potential efficacy and durability throughout the plant life cycle, but also because it would prevent the need for frequent mechanical interventions. Various studies conducted in other countries (DeVetter, 2015) have proven its benefits. In addition to favouring an increase in humidity and protecting the structure of the soil, mulch has a significant allelopathic effect on certain weeds. One of the few papers that focus on this aspect (Stenmaus et al., 2008) has quantified not only its efficacy, but also the environmental and economic benefits that it creates. Its viability is, therefore, a challenge with promising results in organic farming.
The scientific and technical feasibility of the proposal depends on three key issues: 1. assessment of its efficacy on weeds, 2. availability of suitable materials, and 3. suitable implementation in the field. The first point constitutes the core of the proposed project and preliminary studies undertaken in the 2017 season have produced very promising results. With regard to the availability of material, there should be no serious difficulties as these products are easy to obtain in suitable quantities from dehydration, fodder, forest clearing and similar companies. The third point, large-scale implementation, is in principle the most uncertain as there is no technology specifically designed for this purpose. However, in this sense this project proposes as a challenge for the task force the adaptation It should also be stated that, once the study has been completed, the production system is to be analysed from the agronomic, environmental and financial perspectives.

Pending the agronomic efficacy results, the environmental advantage can be considered to be guaranteed, given the natural origin of the products to be used and the reduction of the number of mechanical interventions, and it is also expected to be financially advantageous as the cost of the materials is low.
The costs of bioherbicide products and their application should also be assessed by analysing the life cycle of the production process with this crop management system (mulch and/or bioherbicides).

## Expected results and practical recommendations

The expected results focus on:
1) The development of new strategies to control weeds at organic vineyards.
2) The creation of innovative tools that enable economic savings in the production system and at the same time reduce greenhouse gas emissions.
3) The reduction of the use of the synthetic herbicides usually applied under vines.
4) The reduction of soil erosion caused by under-vine weeders.
5) Favouring the conservation of soil and its associated biodiversity.

The applicability of the results must enable the definition of a new concept of weed management at vineyard, particularly in organic production systems. The results are expected to enable the application of the methodological proposals in two ways:

1- As tools to improve the control of weeds at vineyards.
2- As a possible strategy to transfer to other organic production facilities (fruit orchards, intensive olive farms, etc.).

The task force encourages and recommends the various agents in the sector to become directly involved in research and experimental work involving challenges that are yet to be overcome by organic vineyards and the farming sector in general. The reduction of dependency on phytosanitary products, including herbicides, represents a step forward towards a future strategy and the improvement of competitiveness. This is why the aim of this project is not only to generate effective methods, discoveries and techniques, but also to foster the integration of biological and agronomic knowledge through research, the development of new strategies to support decision-making and transference to the socioeconomic sector.

### Task force leader


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## Subject area(s) of application

- Farming/forestry competitiveness and diversification
- Farming practice
- Fertilisation and nutrients management
- Plant production and horticulture
- Water management

## Geographical area(s) of application

| *Province(s)* | *Region(s)* |
|---|---|
| Lleida | Segrià |

## Dissemination of the project *(publications, conferences, multimedia...)*

The results dissemination plan of the project is structured into three different levels:

1- Dissemination to the general public: this includes campaigns in the media and on news and dissemination websites, participation in roundtables and science dissemination events (e.g. workshops, Science Week in Catalonia, science and agriculture programmes on the radio and TV and in the press).

2- Technical dissemination: publication of the main and most applicable results in farming dissemination magazines (e.g. Phytoma, Vida Rural, Agritultura, Tierras, etc.), participation in working groups and technical meetings of the Spanish Society of Horticultural Science (SECH), the Spanish Weed Control Society (SEMh), Phytoma technical seminars, the Spanish Society of Plant Health (AESAVE), etc.

3- Preparation and publication of technical reports, e.g. DARPA (Ministry of Agriculture, Livestock, Fisheries and Food) technical sheets, collaborations on websites and the newsletters of various societies and associations.

It should be stated that the aim is also to take advantage of the experience of the members of the project and the channels open to them with regard to communication in order to expand the scope of the various activities that are proposed. The diversity of the profiles of the project's participants will facilitate the publication and citation of the advances made among the scientific community and stakeholders in the agriculture sector.

## Project website

## More information on the project

### Project dates

Starting date (month-year): June 2018

Completion date (month-year):

Current status: *Underway*

### Budget approved

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|---|---|
| **Total budget:** | **€157,200.00** |
| *DARP funding:* | *€64,227.60* |
| *EU funding:* | *€48,452.40* |
| *Own funding:* | *€44,520.00* |

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*Order ARP/133/2017, of 21 June, approving the regulatory bases of grants for cooperation for innovation through the promotion of the creation of European Association for Innovation task forces in terms of agricultural productivity and sustainability and the execution of innovative pilot projects by these groups.*
*Resolution ARP/1868/2017, of 20 July, calling for applications for grants for the year 2017.*

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