

ProEcoWine

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Publishable Summary

Fungal diseases like downy mildew and Botrytis can cause enormous damage to grape growers all over Europe. European grape species are especially susceptible. Once the vineyard is infected, the wine grower will have to cope with immense yield losses and impaired wine quality. Current methods of treating and preventing fungi in traditional and also in organic farming involve the use of copper fungicides. Although the European Council Regulation on Organic Agriculture limits copper application to six kilograms per hectare and German organic farming associations voluntarily do not exceed the amount of three kilograms per hectare, copper can accumulate in the soil, leading to toxicity in useful soil microorganisms. Furthermore, those fungicides are not compatible with other pesticides and thus may cause phytotoxicity or destroy proteins in plant tissues causing 'vine damage.' Therefore, the EU requires that the amount of copper applied per hectare and year must be reduced during the next years. At present, there are no efficient alternatives to replace copper as a fungicide in organic viticulture. Therefore, an economical solution is required to support the development and growth of the organic market. ProEcoWine is a project funded by the European Commission formed by a trans-European partnership of three research performers, five small and medium enterprises supported by a large company, and an association for organic agriculture. Coordinated by the Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB, the project's objective is to develop a novel bio-plant protection product to treat common grapevine fungal diseases, and thus to replace copper fungicides in organic and conventional viticulture. To achieve this, two microalgae strains which reliably inhibit fungal properties were cultivated and further processed into a plant protection product.

The main project objectives were:

1. To enhance scientific understanding in the areas of:
 - i. Fungicidal properties of microalgae to achieve high antifungal efficiency
 - ii. Production parameters for high density growth
1. To optimize parameters for the scale-up production, processing, and storage of microalgae preparations for application as a fungicide
2. To identify possible development of resistant fungal pathogens induced by the developed products

To validate and optimize application of the final product for maximal efficacy against downy mildew and Botrytis in greenhouses and field trials in two vineyards in Europe

Several microalgal strains against downy mildew and Botrytis were successfully cultivated by the University of West Hungary (UWH) under different conditions. They were screened for antifungal activity and two microalgal strains were identified to have the most efficient control (more than 90%) against downy mildew and Botrytis. Subsequently, the antifungal activity of these two strains was validated in greenhouse experiments. The two successful strains then moved on to the next stage of in vivo experiments, where their antifungal activity was validated in greenhouse and field experiments.

Fraunhofer IGB focused on establishing effective and economic cultivation methods for high microalgae density growth using their developed flat-panel airlift photoreactors. The photobioreactor system was equipped with a control system for airflow, temperature, pH, and light intensity. The results of this task were delivered to Algafuel SA (A4F), who was in charge of the scale-up of microalgae production for the further product development. A4F successfully cultivated the microalgae outdoors in Portugal and harvested it using the separation technology of Alfa Laval Corporate AB.

Next, the evaluation of downstream methods required for the activation of antifungal activity was carried out by Fraunhofer IGB to establish the most cost-effective process for the ProEcoWine product manufacturing. The optimal formulation of microalgae concentrate was determined, resulting in developed ProEcoWine products with enhanced shelf life. This was possible with the contribution of project partners Kürzeder & März and IAU Service and their extensive experience in product formulation. The antifungal activity of the developed products was monitored by project partners UWH and Phenobio and showed that the ProEcoWine products fully inhibited the presence of pathogens and had no adverse effect in plants (phytotoxicity).

First field trials with the ProEcoWine products were carried out in France by Les Vignerons de Buzet Societe Cooperative Agricole, in Spain by Viñedos de Aldeanueva Sociedad Cooperativa and in Germany by IAU Service. The products were applied using conventional spraying equipment in viticulture. Although the results in southwest Europe could not be fully evaluated due to weather conditions, the results in Germany were very positive: the algae- based fungicide had comparable success rates as commercial copper-containing fungicides and the infection rates of grapes and leaves were lower than with untreated plants.

The association for organic agriculture Naturland provided feedback on the performed field trials and product certification process. All partners worked very actively in dissemination and exploitation activities. The results of the project were presented in several trade shows, exhibitions and scientific conferences.

With these promising results, the SME partners intend to design and build a demonstration plant to produce the algae- based fungicide for further field trials in different wine regions and climatic conditions within Europe at a low cost. Upon completion of this test phase, the SME partners plan to work in the certification and commercialization of the product.

Our innovative microalgae plant protection product will enable the replacement of copper fungicides in organic and conventional viticulture, increase yield in organic vineyards by up to 30% and decrease production costs per unit by up to 20%. This will increase the competitiveness of EU wines and support the development of the organic market in Europe. Within 6 years of project completion and after 5 years of marketing our product, we anticipate a 16% share of the fungicide market for our primary application (treatment of downy mildew grapevines).



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