innovine

INNOVATION IN VINEYARD

Publishable summary of the activities performed

during the first year of the project -2013

SEVENTH FRAMEWORK PROGRAMME

European collaborative project funded by the European Union

FP7 Knowledge Based Bio-Economy (KBBE) program

Grant Agreement n° 311775

WP1: Effects of vineyard practices and environment on grapevine and berry in relation with climate change

Objectives of the WP for the period: The first objective of WP1 for this period was to agree on a set of sampling and analytical procedures related to berry ripening, that might be used in a standard format for modelling studies. The second objective was to test and try to improve several non-destructive phenotyping tools based on fluorescence and IR sensors, thermography and hyperspectral imaging in order to monitor canopy development and berry composition. The third objective was to start to collect a full set of phenotypical and berry composition data for a wide range of different varieties cultivated in different locations and under different vineyard and canopy management practices. This also extended to comparisons of varietal and clonal diversity of grapevine plants.

Work done since the beginning of the project: Agreement has been reached on a common set of phenotyping and analytical procedures, which have been sent to the Innovine participants of all WP for consistency across WP when relevant. Several non-destructive phenotyping tools (Multiplex, hyperspectral imaging, thermal imaging, reflectance) were tested in different locations. Experimental plots were set up and monitored by the different WP1 participants.

Main results achieved so far: A common set of phenotyping and analytical procedures has been dispatched throughout the consortium, and used to monitor plant development and berry ripening on various genotypes (Cabernet franc, Cabernet Sauvignon, Sauvignon blanc, Tempranillo, Tempranillo Blanco, Sangiovese, Touriga Nacional …) exposed to various environments (water availability, CO2) and vineyard management (modification of the sink/source ratio). Berry content is under analysis. The experiments will be repeated next year.

Expected final results and their potential use: Technical assays should lead to improvement and spread of non-destructive phenotyping tools. Phenotypical and analytical data will be used to model berry ripening and composition under different environments. This will be useful for interactions with other WPs and decision making tools for grapegrowers.

WP2: Designing optimized vineyard practices to reduce pesticides

Objectives of the WP for the period: The main objectives, transversal to all tasks, of this WP for the first reporting period (P1) was to deliver, and then to apply, shared protocols for data collection (growth, yield, grape composition and pest assessment). The establishment of new experimental vineyards was required to complete the set up of field trials in already existing vineyards. Finally, the interrelationships with other WPs were also calibrated.

Work done since the beginning of the project: Work needed to fulfil the above objectives was performed in time and in accordance to the proposal. In more details, in Task 2.1, UCSC and IGA finished to establish (vineyard plantation was started in advance of the official kick off of INNOVINE) the experimental vineyard comprising both resistant and susceptible cultivars, INRA collected strains of downy mildew developed on resistant varieties, whereas JKI started preliminary assessment of disease incidence on their resistant genotypes. GRC, in collaboration with Force-A, provided a preliminary screening for flavonols production and remote pre-symptomatic downy mildew assessment. In Task 2.2, with no exception, each partner started the scheduled field trials based on the application of various treatments including leaf removal and shading, hand bunch removal, mechanical berry thinning, minimal pruning and anti-transpirant application. In Task 2.3, while the biodiversity assessment in plots treated with different pest protection pressure was postponed to 2014 by GRC, UCSC imposed and started to evaluate different sanitation treatments to limit infections of downy and powdery mildews including: i) fire ii) bio control agents (as Trichoderma and Bacillus spp.) and iii) composting of leaf debris. Finally, in Task 2.4, UCSC and Horta showed a quite effective coordination at implementing modeling tools for disease predictions. Both teams evaluated epidemiological parameters of downy mildew of six resistant varieties vs. one susceptible variety while a sub-routine of the model devoted to phenology of resistant varieties is also being developed. Moreover, first experiments were set up to investigate the relationship between downy and powdery mildew severity on bunches and yield and quality losses.

Main results achieved so far:

• Task 2.1: several partners (UCSC, IGA and JKI) provided either no or partial observations mostly due to still too young vineyard age. INRA observed a good level of resistance to downy mildew in among the resistant varieties to downy and powdery mildews, with some of them (Cabernet Carbon, Johanniter, Solaris) showing higher disease incidence on leaves. They also observed an unexpected increase in downy mildew epidemics on leaves at the end of the season (harvest period). Severe black rot attacks were observed on clusters on all the resistant varieties planted.

• Task 2.2: the quality of the preliminary data sets gathered insofar is quite high since changes in leaf area to fruit weight ratio impacted on grapevine phenology in various stages of development restricting fruit-set, loosening cluster compactness and reducing cluster weight, crop load and the susceptibility to bunch rot as well as impacting on the velocity of berry ripening.

• Task 2.3: Infected leaves have been collected at fall for the experiments and since the sanitation is targeted on the overwintering inoculum of the pathogens, at the time this report is submitted, the experiments are ongoing.

• Task 4.1: preliminary results demonstrate that there is a different behavior of the same pathogen population on different grapevine varieties, while first collected data of the disease severity and yield loss relationship hints to a fairly close, yet non-linear correlation.

Expected final results and their potential impact and use: The philosophy underlying this WP2 is that a significant reduction in the amount of pesticides used in grapevine protection can be achieved only under a multi-target approach assisted by model-based predictions which joins together the following items:

i) broader use of new varieties having durable resistance to fungal disease and good organoleptic wine profile;

ii) induction of indirect bunch tolerance to rots through agronomically-driven desirable changes in bunch or berry morphology;

iii) application of sanitation treatments under the aim of reducing the pressure of standard pesticides and development and refinement of pest modelling suitable to better define if and when to spray and to estimate which fraction of disease incidence can be tolerated with no detriment for yield and quality targets.

WP3 : Exploiting the genetic diversity in grapevine

Objectives of the WP for the period: *Vitis vinifera* is generally considered to be susceptible to powdery mildew and downy mildew as well as other pests (e.g. phylloxera) and diseases (e.g. black rot). Thus, a few years ago surprisingly a resistance (designated as Ren1) against powdery mildew was identified giving hope to find further resistances in particular in accesses originating from Eastern Europe/Near East but also within the genepool of *Vitis* and *Muscadinia*. Therefore within INNOVINE grapevine genetic resources will be screened to identify accessions providing new source of resistance to powdery mildew and downy mildew, black rot, and phylloxera. Besides biotic stress evaluation accessions are being screened for abiotic stress tolerance.

Work done since the beginning of the project: Screening for biotic and abiotic stress has been initiated and done. Protocols were exchanged and harmonized. Plants were grown and subjected to either of the various stresses. Symptom/stress development was monitored and rated.

Main results achieved so far: Preliminary data indicate interesting new source for resistance. These first promising results need to be verified in subsequent analyses. Some interesting genotypes were observed showing increased resistance against powdery or downy mildew, respectively. Black rot screening revealed high resistance in some of the selected cultivars. Similarly indications for phylloxera resistance in *Vitis aestivalis* have been recognized. Draught stress analysis is in progress.

Expected final results and their potential impact and use: We expect a few accessions showing new desired resistances. This material can be used for further breeding purposes supporting grapevine improvement.

WP4: Conception and test of sustainable viticulture practices or systems

Objectives of the WP for the period: The overall aim of WP4 is to conceive and assess under real vineyard conditions the cost-benefits relationships of new practices and management systems aiming at adapting viticulture to climate change, at reducing pesticide application and at optimizing precision viticulture practices. These assessments include not only economic but also environmental impacts and technical feasibility. The main objectives for this period are:

• a first objective is to design, develop and test innovative viticulture systems, at a vineyard level, which integrate new agricultural practices while taking into account the variability of constraints met by European vineyards grown under a wide range of environments (task 4.1.)

• a second objective is to do a design-assessment cycle to ensure validation and improvement of the innovative sustainable vineyard systems. For this reason, during period one, the first step has been the definition of Sets of Objectives and Constraints (SOCs) for the main types of European viticulture, interacting with relevant stakeholders (subtask 4.2.1).

• a third objective involves the identification of specific data to perform cost/benefit analysis and to calculate the environmental impacts of the innovative vineyard management strategies. Also the preparation of a future a map of the viticulture management systems for a future identification of the critical points and priority axes of improvement; and finally the definition of common protocols for experimental design and data collection necessary to evaluate the management options compared (task 4.4).

Work done since the beginning of the project: Viticulture practices have been established at a vineyard level, for the first objective. Different agronomic promising essays concerning defoliation, irrigation, training systems, pruning, trimming and plant density have been perform in order to measure how they can affect water use efficiency and microclimate in different grapevine cultivars. Experimentations are carried out in mediterranian and continental conditions. Field data and laboratory tests have been executed in order to have the first results aiming at the mitigation of the negative effects of climate change. Also different clones have been analysed, in different vineyards, with the aim of adapting, not only to climate change conditions but also concerning quality and response to the main disease fungal. The application of new tools, in precision viticulture, focusing on applying non-invasive sensors for grape composition and quality, have been tested. The study of the Multiplex indices for estimation of the anthocyanin content for red varieties is being started and it is still in progress. Concerning the second objective, contacts with several partners have been taken, in order to establish the Sets of Objective and Constraints. Key partners in different countries have been identified and contacted. For the third objective an excel file was prepared with the purpose of collect all the data necessary to perform analysis related with cost/benefit and environmental impact. The preparation of a web survey with the aim of drawing a map of the viticulture management systems, in use at the moment. A common protocol was established for data collection of WP4 vineyard experiments.

Main results achieved so far: Field data concerning vegetative, productive and maturity controls have been collected by partners involved task 4.1. Wine analyses, meteorological data and disease controls have been done by the majority of the partners participants in this task. SOCs in Spain are already defined for the major wine production areas. For other countries the contacts were carried out but the SOCs are not finished. This excel file for the cost/benefit and environmental impact analysis was circulated to all WP4 partners and the first data have been collected. The preparation and translation in five languages, for the web survey, has been completed. Also a deliverable was submitted for a common protocol for experimental design and data collection (Deliverable 4.1. – Protocol for statistical analysis in WP4).

Expected final results and their potential impact and use : Since the overall aim for task 4.1 is testing viticulture practices aiming at mitigations the negative effect of climate change on berry quality/or reducing the use of pesticides, final results in terms of field data and laboratory analysis will be of a great importance in order to compare the traditional systems with the innovating ones.

The establishment of the SOCs are decisive to define different practices in coherent systems in order to reach major modifications in production systems while allowing the European viticulture to face adaptation to new conditions. In this sense, task 4.2 will design innovative vineyard systems to deal with these climatic conditions and to optimise energy.

W5: Implementation of decision support systems towards a sustainable viticulture

Objectives of the WP for the period : The general objective of WP5 is to develop decision support systems (DSSs) for sustainable viticulture, able to support European vine growers in taking optimal decisions about: (i) management of abiotic stresses (e.g. frost injuries, water stress); (ii) control of pests and disease; and (iii) management of vine canopy. The main objectives of the first year were:

- identify the already available Decision Support Systems (DSSs) for the management of the vineyard
- Identify monitoring tools and information collection systems available for viticulture
- define possible improvements of these DSSs and tools
- when possible test the new functionalities improved in field and implement them in the different DSSs and devices

Work done since the beginning of the project : Work needed to fulfil the above objectives has been done accordingly to what expected for the first reporting period. In particular, two main DSSs were identified for the management of the vineyard: vite.net®, provided by Horta, and EPIcure/PTO, provided by Entav. New functionalities were developed for both DSS and were in part implemented in the systems. These new functionalities will be tested in the next grapevine growing season. Also for the monitoring tools, different improvements were performed: new functionalities were developed for the Multiplex tool and for the Smatgrappe. No less improvements were made in the data collection of the Agriciencia weather and plant sensors, as well as for the image acquisitions of Noveltis.

Main results achieved so far: In particular, a new model for estimating the optimal dose of fungicides application, as well as indicators for the environmental impact of vineyard management, were developed and partially implemented in vite.net®. Different data on foliar development were acquired by a new developed kit of the Multiplex tool and integrated in the EPIcure system in order to create future PTO Layers for setting a theoretical synthetic zoning of the vineyard. Agriciencia improved his system for collecting data from multiple sources using last generation sensors, wireless communications and web services for viticulture at farm level. The smartphone based system “Smartgrappe” provided by Irstea was refined to facilitate data collection on quality evaluation of bunches. Finally, NOVELTIS developed a method, based on aerial images, to automatically digitize vineyard boundaries and weather data have been provided to IFV.

Expected final results and their potential impact and use: The approach of WP5 is based on a logical sequence of the activities necessary to achieve the WP’s objectives, with iterative loops of “development – test – improvement”. At the end of the project, improved monitoring devices and DSSs for the sustainable management of the vineyards will be available to the grapevine growers all around Europe.

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To learn more about the project
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