# .- Grape and wine biotechnology

## Prof. Matteo Busconi

***COURSE AIM AND INTENDED LEARNING OUTCOMES***

To give insights on biotechnologies and genomics with a special focus on grape and on wine production. The course will focus on different issues of grape biotechnology: genomics, epigenomics, and transcriptomics of grape in the NGS era; development and use of molecular markers for QTL mapping, evolutionary studies, pedigree validation, and varietal characterisation; preservation of biodiversity; classical and innovative breeding, transgenesis, cisgenesis; genome editing. A last part will be focused on wine biotechnology: recovery of the production cultivars DNA from wine for traceability; proteomics and metabolomics of grape varieties and wines, genomics of yeasts, genomics of wine starter strains, and improvement of wine yeasts.

Learning outcomes:

After successful completion of the course, students are expected to be able:

- to have the most important basic knowledge concerning the application of biotechnologies to grape and wine sector. DNA, the OMICS approaches that are used in grape studies and the identification of useful genes to increase viticulture sustainability;

- to know and to explain how is grapevine breeding carried out by using both classical and innovative approaches, including both genetic transformation and Genome Editing;

- to understand the utility of molecular markers and DNA analysis in characterising grapevine varieties, preserving biodiversity, defining kinship and pedigrees and in assisting breeding by Marker Assisted Selection;

- to understand the utility of genetically modified or genome edited varieties in increasing sustainability of viticulture;

- to understand and to explain the use of DNA, proteins and metabolites for the traceability of wine productions;

- to understand and to explain the most basic aspects of yeast genomics, with a particular focus of genomics of starter strains for wine productions;

- to know the most used methods, both transgenic and non-transgenic, for improving the most important technological properties of yeasts;

***COURSE CONTENT***

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| **OMICS approaches for grape studies** | **1.25** |
| Origin, domestication and evolution of the cultivated species. Characteristics of grape genome. High throughput analyses of grape epigenome and transcriptome. |  |
| **Development and use of molecular markers** | **1.25** |
| Development of molecular markers. QTL mapping of traits of interest. Varietal characterisation, comparison with classic ampelography. Marker assisted selection. Pedigree validation. Preservation of grape biodiversity. Exploitation of local varieties. |  |
| **Genetic improvement of grape** | **1.75** |
| Grape breeding and classical approaches. Methods for introducing genetic variability in a germplasm. In vitro cultures. Recombinant DNA technology. Making of genetically modified transgenic, cisgenic, and intragenic plants. Genome Editing. Breeding for resistance. Rootstocks breeding. |  |
| **Traceability** | **0.75** |
| Cultivars DNA extraction from wine and its use for traceability. Methods to recover cultivar DNA from wine. Procedure for the identification of the cultivars. Proteomics and metabolomics of wine. |  |
| **Biotechnology of yeasts** | 1**.0** |
| Genomics of yeasts. Genomics of wine starter yeasts. Improving technological properties of yeasts. Transgenic and non-transgenic approaches for the modification of yeast genome. |  |
| **Seminars** | **1.0** |
| DNA based traceability of wine productions: the case of a big Italian winery;  Molecular markers and germplasm management;  Marker assisted selection for grapevine breeding and detection of resistance genes against biotic and abiotic stresses;  New hybrid Rootstock: from past to “M”;  Disease resistant varieties |  |
| **Tutorials** | **1.0** |
| Educational visits at a research institute. |  |

***READING LIST***

Papers retrievable from literature and other material that will be provided by the teacher.

Power point presentations will be made available during the course before the beginning of each new topic.

***TEACHING METHOD***

The teaching method will embrace the following activities:

1) Indoor class where main course topics will be covered along with several examples. Each new lesson, starting from the second one, will begin with a 10 minutes refresher of the previous one to recall the main subjects previously addressed. Questions will be posed to stimulate discussion.

2) An educational visit at a research institute (Edmund Mach Foundation, San Michele all’Adige) aimed at understanding, by speaking with researchers having a deep experience in the sector and through the direct vision of practial examples, the possible applications of grape and wine biotechnologies to the wine sector.

***ASSESSMENT METHOD***

Final examination is carried out as an oral presentation of 30 – 40 minutes prepared by students on one of the topics of the course. The speech must not be just a simple exposure of what was learned during the lessons. Students must deepen the selcted topics autonomously, searching and processing new information on the base of scientific papers selected, if requested by students, with the teacher. At the end of the exposure the teacher will pose 3 questions on the topics of the presentation to test students’ knowledge. The score assigned, out of 30, will be determined by students' knowledge and clarity in the presentation of the topics (up to 15 points), mastery of specialised terminology (up to 5 points) and capacity of the candidate to search, process autonomously and report the information retrievable from scientific literature (up to 10 points). Pass mark is 18/30.

***NOTES AND PREREQUISITES***

It is highly recommended that students attend the educational visit, as topics covered during this session have to be considered part of the teaching program.

For the correct understanding of the course contents, it is important, but not fundamental, that students have followed a basic genetics course during the Bachelor's Degree.

Prof. Matteo Busconi is available to meet with students every day at the Section of Agronomy and Plant Biotechnology of the Department of Sustainable Crop Production or online by using the platform Microsoft teams.