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East-West collaboration for grapevine diversity exploration and mobilization of adaptive traits for breeding: a four years story

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Summary

The action aimed at establishing a collaborative partnership among the countries that share the grapevine (*Vitis vinifera* L.) gene pool with the main object to define a core collection able to represent and conserve the highest genetic diversity with the lowest number of plant accessions. The action involved 25 Cost countries and 10 non Cost countries, which represent quite all the range of the Old World viticulture. Around 250 scientists (40.6 % female; 17.5 % Early Stage Researchers (ESRs)) participated to the collaborative activities in which more than 30 institutions were actively involved. Forty-four Short Term Scientific Missions (STSMs) were completed more than two thirds made by ESRs. An original Ampelography Book describing a large sample of elite grape cultivars selected from the native Caucasus and Black northern sea region was published and more than 100 research papers were produced (63 in the present action final publication). Networks of collaborative activities were consolidated. Concrete results involved all the objects of the action, including germplasm identification, testing of advanced genotyping methodologies, accessions phenotyping for phenology, grapes quality potential and mildew resistances; methods for association genetics; procedures for sanitary managements of collections, safe conservation and germplasm circulation. Protocols for phenotyping were released and successfully tested in a large set of grapevine germplasm collections. More than 1000 accessions were genotyped. The design of a tentative core collection referred to east European germplasm was completed.

Key words: germplasm managements, genotyping, phenotyping, wild relatives, core collection.

The action objectives

The grapevine gene pool is particularly threatened in the marginal areas of its distribution range. At the same time, grapevine genetic resources in the presumed area of its domestication (south-eastern Europe and particularly the Caucasus) and along the migration route across Europe are poorly known while enclosing still untapped diversity and richness (MAGHRADZE *et al.* 2012). To address this challenge scientists and breeders need to work together at an

international level to generate knowledge about the valuable diversity, its patterns, processes and correlations with traits such as resistance and grape quality. This Cost action enabled researchers from east and west European countries to work together to explore, on a large geographic scale and in a very wide range of countries, the genetic diversity and mobilize adaptive traits for breeding and sustainable use of this very valuable horticultural crop. Sharing experiences, responsibilities, information and materials for the development of phenotyping methods and association genetics studies in core collections will greatly improve the impact of the research conducted by each partner and will introduce innovative areas of research at the European level, creating beneficial knowledge, long-term conservation and a higher quality of grape production in Europe.

The action development

The action aimed at establishing a collaborative partnership among those countries that share the grapevine (*Vitis vinifera* L.) varietal assortment and gene pool (Table and Figure). Four Working Groups (WGs) were formed:

- 1) Identification and characterization of genetic resources;
- 2) Phenotyping and genotyping methodologies;
- 3) Phenotyping of core collections and association genetics research;
- 4) Strategy for conservation and sustainable use.

The main action objective was to define a core collection which could both represent and preserve the highest genetic diversity with the lowest number of accessions. In order to achieve this ambitious target, it was necessary to involve each country within the geographical range of the historical development of the species genetic diversity. Furthermore, it seemed extremely important to include in the network all those institutions with the availability of national and regional germplasm collections, along with those which were already carrying out research projects aimed to grapevine germplasm exploration by advanced methodologies of genotyping and phenotyping. A peculiar aspect of this action was the new relevant role that areas such as the Caucasian and the North Black Sea regions as well as the Balkans and some North African countries, played. Considering the involvement of the target countries and institutions, the first objective of the action was mainly achieved during the first year of activity. At the beginning of the second year, the list of member countries involved

Table

The governance of the Food and Agriculture Cost action FA1003 "East-West Collaboration for Grapevine Diversity Exploration and Mobilization of Adaptive Traits for Breeding"

Chair	Osvaldo FAILLA (Italy)
Vice Chair	Jose Miguel MARTINEZ ZAPATER (Spain)
Coordinators	Erika MAUL (Germany), Reinhard TÖPFER (Germany) – WG1 Roberto BACILIERI (France), Patrice THIS (France) – WG2 M. Stella GRANDO (Italy) – WG3 Milos FALTUS (Czech Republic), Rafael OCETE (Spain) – WG4
Facilitators	Carmen F. POPESCU (Romania) - Balkans David MAGHRADZE (Georgia) - Caucasus
Chair's assistants	Gabriella DE LORENZIS (Italy), Laura RUSTIONI (Italy)
STSM manager	Anagnostis ARGYRIOU (Greece)



Figure: Map representing the countries officially involved in the action. Cost countries: Austria, Germany, Romania, Belgium, Greece, Serbia, Bosnia and Herzegovina, Hungary, Slovakia, Bulgaria, Israel, Slovenia, Croatia, Italy, Spain, Cyprus, Latvia, Sweden, Czech Republic, Luxembourg, Switzerland, Former Yugoslav Republic of Macedonia, Poland, France, Portugal; other: Albania, Armenia, Azerbaijan, Georgia, Montenegro, Morocco, New Zealand (not shown), Republic of Moldova, Russian Federation, Ukraine.

in the Cost action managed to cover almost the whole distribution range of the Old World viticulture, including both the primary and the secondary centres of grapevine domestication and diversification (Figure). Unfortunately, despite attempting it more than once, Turkish colleagues were unable to officially participate in.

In the second year of the action, the activity focused on changing the perspective of researchers involved in grapevine germplasm conservation at different levels. The aim was to develop a new, innovative operational networking. Scientists involved in the germplasm conservation have to face great difficulties from a financial and organiza-

tional point of view. Indeed, they consider the conservation process itself as the most successful achievement of their mission. They are aware of the fact that germplasm repositories represent a milestone in the conservation of the biodiversity of a crop plant, and they know that in order to shift from a mere conservation strategy to a valorisation approach, a massive organizational and financial effort needs to be done. This effort should be mainly directed in the development of methods in phenotyping that should allow medium- high-throughput data recording in field condition with the objective to describe year by year the accessions performance in the perspective to assess their

productive and qualitative value. In addition to the methodological problems, a not negligible obstacle is frequently represented by the location of the germplasm repositories, often far from the laboratories of the research station and frequently split in more than one location. On the other hand, scientists involved in the developing of molecular tools and analytical procedures for genotyping and phenotyping, who operate in very few western European institutions are often frustrated by the difficulties on relying on plant material representative of the full range of biodiversity of *Vitis vinifera*, adequately identified, characterized and phenotyped. Starting from these considerations, the activity of the second and the third year were mainly directed to establish and/or to reinforce the networking through the Action partners. The second and third year, activities (2012-2013) were very dynamic in terms of the action progress as well as extremely promising in terms of the objectives due to achieve. The fourth and last year was then focused on the preparation of the final conference and the publication aimed at officialising and formalising the obtained results.

The action achievements

As reported in the Action's title, "East-West collaboration" worked in the proper way. High equipped Western laboratories have opened their doors to eastern European researchers for the activities of identification of their genetic resources. Early Stage Researches from Balkans, Caucasian and North Black sea Regions have organized Short Term Scientific Missions (STSMs) in Western laboratories to raise their professional competence and to develop collaborative research work. A Training School (TS) on specific screening protocols for resistance to *Plasmopara viticola* (downy mildew) and *Erysiphe necator* (powdery mildew) was completed.

Working group 1: Progresses have been made in the development of the European *Vitis* Database as main instrument for collecting and document the information concerning the grapevine germplasm. More than one thousand accessions mainly from east Europe have been genotyped and identified (MAUL *et al.* 2015).

Working group 2: An important achievement of the action was the formation of a voluntary network for the testing of new protocols for phenotyping in field collections to gather data regarding numerical phenology and the evaluation of the enological potential of the accessions (RUSTIONI *et al.* 2014a, 2014b). Protocols for screening germplasm for mildews resistances were adopted and applied by more than one participant institution. As attested by several joint publications of the present special issue, a large involvement of researchers from east Europe to acquire skill and knowledge on modern genotyping methods has been reached.

Working group 3: The prospect to design core collections including east European germplasm is now really accessible and partially completed (GRZESKOWIAK and GRANDO 2014).

Working group 4: Two reference protocols to be adopted for genetic resources sustainable conservation and safe circulation among repositories have been agreed and released in the present publication (MAGHRADZE *et al.* 2015b, FALTUS *et al.* 2015). The conservation status of the wild *Vitis vinifera* has been surveyed in the Caucasus (MAGHRADZE *et al.* 2015a) and a proposal for the wild *Vitis vinifera* L. conservation in the European and neighbouring countries has been prepared (OCETE *et al.* 2015) to be submitted to the European governmental authorities.

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To be Chair of the Cost action FA1003 was for me a very rich experience both from the human and the professional point of view. I really appreciated the strong and genuine willing of all participants to give their own contribution to the success of the project, trying to go over any possible difficulty in the personal relationships as well as in the organizational framework. I hope that the young researchers, that participated to the action works, may be able to follow this positive example.

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