

Research Note

Grapevine germplasm collections of Switzerland

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Introduction: Switzerland has a long tradition in wine production. Today almost 15,000 ha of grapevine are planted for wine production. 42 % are planted with white varieties and 58 % with red ones (Boss 2014). Until the end of the nineteenth century the cantons Vaud, Ticino and Zurich produced the largest amount of wine in Switzerland (SCHLEGEL 1973). After the invasion of phylloxera (*Dactulosphaira vitifoliae*), downy and powdery mildew (*Plasmopara viticola* and *Erysiphe necator*) in the late 19th century and the development of the wine market, Swiss viticulture evolved from self-consuming production to commercial wine production which is organized in wine-marketing areas. In that context, the most important vine-growing cantons became Valais and Vaud related to their climatic conditions and extension possibilities. In the Valais, for example, the viticulture area grew from 1000 to 5000 ha between the end of the 19th century and 1970. Today, Valais, Vaud and Geneva are the most important wine-growing areas of Switzerland in terms of planted area (Boss 2014). Since 1900 Switzerland is maintaining germplasm collections for cereals and later also for berries, fruits and vegetables. The Swiss grapevine national collection of Agroscope Pully (VD) started in the 1920s and is today an international reference for varieties grown under alpine conditions. Since 1999 also privately maintained grapevine collections belong to the national network, related to the Action Plan for the Conservation of Genetic Resources (KLEIJER *et al.* 2012) in the frame of the Second Global Plan of Action for Plant Genetic Resources for Food and Agriculture (www.fao.org). All available data related to the collections are registered in a central free accessible database (www.bdn.ch). In the following sections we report on four main grapevine germplasm collections (Figure) which are partially supported by the Swiss National Action Plan.

Material and Methods: Different collection types are maintained in Switzerland, belonging to the concept of the

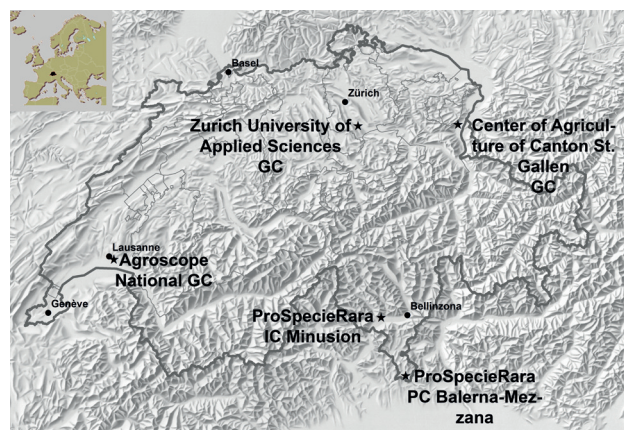


Figure: Locations of Swiss grapevine germplasm collections. Stars indicate the geographic position of the grapevine germplasm collections of Switzerland. GC, germplasm collection; IC, introductory collection; PC, primary collection. Source of maps: Switzerland, Federal Office of Topography swisstopo; map insert of Europe (atlas.challenges.fr).

National Action Plan, including a positive list of the cultivars to be conserved with actually 142 listed names. The material to be conserved after the positive list can be summarized as follows: (1) Swiss bred or locally selected cultivars, (2) cultivars having a relation with the Swiss socio-cultural heritage and (3) unknown or not named cultivars until their origin and importance is defined. Additional different rare foreign cultivars and curiosities are maintained in these collections as well.

The national reference collection at Agroscope Pully (VD) is internationally recognized and contains in particular varieties adapted to the alpine climatic conditions. Two introductory collections (Frümsen and Minusio) are used as intermediate collections to study the cultivars in expectation of their conservation status. Primary/Duplicate collections (Frümsen, Balerna-Mezzana and Au ZH) are designated for the long term conservation of the initial material. If nothing else is indicated in the text the data and numbers are taken from Swiss national database available at www.bdn.ch. Different database entries under descriptor VARNAME were counted to establish the number of varieties. The different entries for ACCENAME were summed for the number of accessions. The total entries in ACCENAME represent the total number of plants within the part of the collection being included in the database. The descriptor VARORIGIN was counted to estimate the variety's origins.

Results: The grapevine germplasm of Switzerland is spread to different collections situated at five locations (Figure). According to the national database they comprise in total 505 different varieties (640 different accessions) conserved by an average of 12 plants/accession. These varieties comprise 92 varieties originating in Switzerland in a sense of being bred and/or selected within Switzerland or of being for a long time period cultivated in Switzerland. The remainders originate, if documented in the national database, in 15 European countries as well as in Iran, Japan and the USA. Twenty-six different varieties from seven Eastern

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Table

Eastern European grapevine varieties maintained in Swiss germplasm collections

Country	Cultivar name
Hungary	Bianca, Fanny, Furmint, Harslevelü, Kadarka, Koenigin der Weingaerten, Mathiasz Janosne, Nero, Perle de Csaba, Perle de Zala, Putzscheere
Romania	Feteasca alba, Coarna neagra, Feteasca
Turkey	Chaouch, Sultanine rose, Sultanine blanc, Sultanine rouge
Bulgaria	Muscat de Roussé, Muscat du Danube, Roubine
Georgia	Rkatziteli, Saperavi
Croatia	Croatina
Moldova	Kimisch lutshitsii, Kodreanka

European countries are maintained in Switzerland (Table). These varieties are not of economic importance. Of all varieties 314 are located only in one collection and 67 in two; eight are present in all four collections. Three varieties are present as a single plant only, 23 exist in duplicates, 106 are maintained in three replicates, and the remainders in four or more replicates. 40 % of the varieties are maintained in more than ten replicates. The following sections specify the results for each of the four collections.

Agroscope: The National Germplasm Collection of Switzerland is established at Agroscope Pully, situated along the lake of Geneva. In total 3,516 vine plants are cultivated in this reference collection, representing 456 different accessions being maintained in three to ten plants each one (VIRET, unpublished). In the cases where the varieties' places of origin are known, they are located in 15 European countries as well as in Iran and the USA. Of the collected varieties 59 have a Swiss origin.

Zurich University of Applied Sciences: The Zurich University of Applied Sciences, ZHAW, maintains on the shores of the Lake of Zurich a grape variety collection of about 250 grapevine varieties on 0.4 ha. Today the collection maintains Swiss and Western-European varieties including about 60 varieties of fungi-resistant interspecific crosses (FAHRENTAPP, unpubl.). About half of the collection, 126 varieties (126 different accessions), belongs to the Swiss-national program for the conservation of plant genetic resources and is included in the national database. These varieties are maintained mainly in five plants each. Some varieties are planted in higher numbers leading to a total of 865 grapevines in the collection. 55 grapevine varieties of the collection originate in Switzerland, 14 in European countries and two in Iran and USA.

Center of Agriculture of Canton St. Gallen: The grapevine collection of the Center of Agriculture of Canton St. Gallen is located in the Cantonal Vineyard at Frümsen. According to HARDEGGER and OPP-LIGER (unpublished) this collection is split into five sub-collections: (1) A primary/duplicate collection comprising 154 varieties in 5 plants each, (2) an introductory collection with 33 varieties in six to twelve plants each, (3) a special collection with 187 varieties in two to four plants, (4) a collection of fungi resistant hybrids comprising another 18 varieties and (5) a collection of muscat varieties, with seven different types of Muscat. All together the varieties in the five sub-collections come from ten different European countries as well as from Japan and the USA.

ProSpecieRara: ProSpecieRara is a Swiss foundation for historic and genetic diversity of plants and animals. The grape variety collections are situated in southern Switzerland in the Canton Ticino at Balerna-Mezzana (primary collection) and Minusio (introductory collection). These collections comprise 159 varieties in two to twelve plants each leading to a total of 1,545 grapevines within the collections (BURGER, unpublished). The collected varieties originate from six European countries and the USA. A total of 54 varieties have their origin in Switzerland. Besides the collections Balerna-Mezzana and Minusio ProSpecieRara maintains additional small private collections. Summed up they maintains 163 varieties in 1,601 grapevines.

Discussion: The Swiss grapevine germplasm is very well distributed all over the country in different collections at five different locations. According to the summarized results based on the analysis of the national database, the different holding institutions should put forward an effort to maintain each variety at least at three locations with a minimum of four and in case of new accessions of at least five plants each, according to the new protocol of MAGHRADZE *et al.* (2014).

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