

THE FEM GRAPEVINE BREEDING PROGRAM: NEW REGISTERED VARIETIES (MID-)RESISTANT TO THE MAIN AMPELOPATHIES

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Abstract:

Context and purpose of the study – "*Vinum debet esse naturale ex genimine vitis et non corruptum*". The Eucharistic wine must be made with pure grapes that must not be contaminated in any way. This is how wine was born in the monastery of the Augustinians, and that is how the genetic improvement of grapevine implemented over the decades at the Agricultural Institute of San Michele all'Adige (since 1874; Trentino - Italy) has been oriented to make the cultivation of grapes always more sustainable. This concept is still current and meets the worldwide urgent need of reducing the use of chemicals, under a climate crisis scenario. Since the beginning of the twentieth century, the varieties introduced in Trentino and the new cultivars produced by pioneer breeders have already embraced the principle of sustainable viticulture. During this first phase it was mainly focused on the search for agronomical and qualitative improving characteristics, while a second phase concentrated on the breeding activity for resistance to biotic stresses began in 2010 at the now-established Edmund Mach Foundation (FEM).

Material and methods – The technique of crossing, free or controlled, has always been a source of variability and introduction of characters that are not present in the parents. Unlike biotechnological approaches, since the beginning crossbreeding deals with products selected under climate change conditions.

The first established approach was based on i) "*vinifera x vinifera*", in particular Teroldego X Lagrein and Malvasia di Candia Aromatica X Muscat Ottonel populations created in the '90s. The F1 progenies obtained were selected on 1-25-100 plants for qualitative/quantitative parameters of grape and chemical/sensorial analysis of must/wine upon microvinification. The selected genotypes were characterized by DNA fingerprinting, ampelographic and ampelometric descriptors, phenology and wine profiling. The overall evaluation of various parameters allowed for the identification of some genotypes with looser clusters than those of their parents, in association with a minor sensitivity to Botrytis bunch rot, and other ones with earlier ripening time or different anthocyanin/tannin content. The second strategy followed two objectives, both related to the implementation of multiple disease resistance in the breeding program. The plan ii) "*vinifera x non-vinifera*" aimed at obtaining resistant materials with the historical varieties of Trentino as a noble parent (e.g. Teroldego, Nosiola), using genotypes acquired from other breeding programs (e.g. Merzling) as disease resistance donors. For the plan iii) "*non-vinifera x non-vinifera*", upon an initial phase of scouting the FEM complex genetic pool of resistance traits to the main ampelopathies, a group of accessions were selected as resistance donors. They were used as parental lines in the process of introgression and stacking (or "pyramiding") of resistance loci (genomic regions) for downy and powdery mildew: the final goal was to obtain a durable resistance on the leaf and in particular on bunches. Thus, through Marker-Assisted Parental Selection (MAPS), various genotypes with stacked loci reached the open field and were then used for breeding purposes. Subsequently, the optimization of phenotyping and genotyping protocols was conducted for a time-efficient and cost-effective Marker-Assisted Seedling Selection (MASS). Recently, several genotypes were screened also for black rot resistance and a comprehensive study has been carried out to dissect the genetic basis of this "emerging" disease towards the development of a marker toolkit.

Therefore, during almost 150 years, FEM moved from the grape for mass to the grape from MASS.

Results – Upon multi-year agronomic surveys, grape quality composition and wine tastings, in 2018 four new varieties were registered at the National Register of Grapevine Varieties, in particular for their novel organoleptic characteristics and resilience to Botrytis bunch rot. Indeed, in 2020 additional four new (mid-)resistant varieties to downy and powdery mildew, as well as black rot, were patented. Being employable for various enological goals,



these new releases - along with several upcoming prototypes - pave the way towards a more sustainable viticulture.

Keywords: Black rot, Downy mildew, Marker-assisted breeding, Resistance loci, Powdery mildew, Vitis.