



High Performance Roses: a new impulse for garden roses by molecular marker technology

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In recent years the market for garden roses has seen a strong growth in Central and Eastern Europe. Unfortunately, the continental climate in these regions limits rose cultivation as the plant may freeze during the cold winters or stop with recurrent flowering during the hot summers. This project will enable marker-assisted breeding (MAB) in this tetraploid crop, starting with two essential traits for these new markets: winterhardiness and recurrent flowering.

Winterhardiness is the result of a combination of physiological processes, including early closure of growth and buds, frost tolerance, and a delay in bud break in spring (so that damage due to late spells of frost can be avoided). Canadian cultivars have been bred for winterhardiness, so that they can withstand up to -45°C. Depending on the parental hardiness level very hardy offspring can be obtained in one to three generations of breeding, which suggests that winterhardiness in roses is controlled by a very few major genes or closely linked genetic factors. Unfortunately, the Canadian roses otherwise have limited value, as many are climbers and the diversity in flower color is very limited.

Recurrent flowering is one of the key characters crucial for the success of roses as ornamental crops as it leads to superior genotypes flowering throughout the whole growing season. This trait was introgressed from *R. chinensis* and *R. odorata* in the early 19th century. It affects the vernalization requirement of rose shoots. Recurrent flowering is based on a single recessive gene. However, the phenotype depends also on other physiological processes, as recurrent flowering stops at high temperatures, as is also the case in cultivated strawberry, where additional QTLs have been identified that are necessary to protect from heat stress in order to maintain the expression of the recurrent flowering gene.

The project aims to deliver

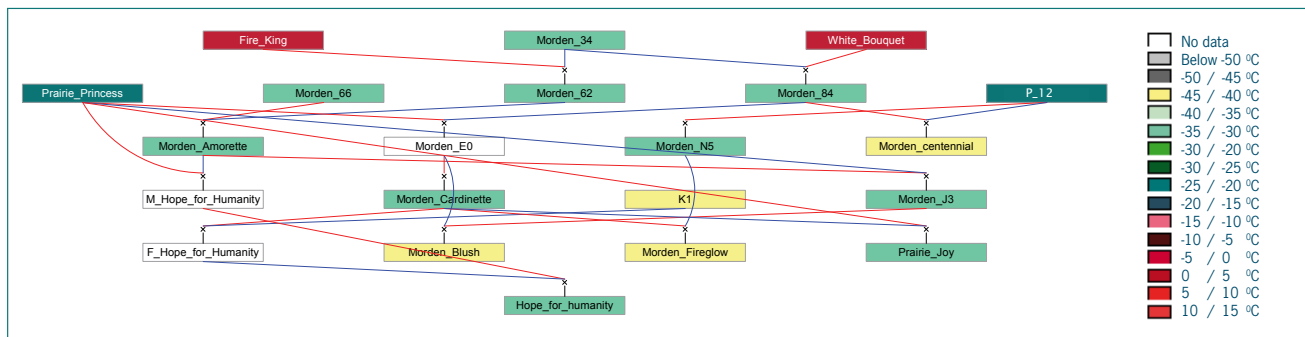
- a core set of molecular markers for directed, genome-wide genotyping of tetraploid roses
- statistical software to identify the four different haplotypes of tetraploid roses
- pre-breeding material for winter hardiness and recurrent flowering
- tools for marker-assisted breeding (MAB) for these traits, including
 - knowledge on the genetic basis
 - knowledge on their robustness of QTLs over environments
 - markers for winter hardiness and continuous bloom, e.g. as SNP/SCAR markers applicable for high-throughput genotyping

Innovative aspects include

- Quantitative assessment of allele dosages in tetraploids
- Pedigree Based Analysis (PBA) for QTL identification and allele mining based on multiple populations, cultivars and breeding lines
- Use of statistical approaches and software dedicated to trace and quantify putative inter-locus interactions in the QTL mapping procedure



Some offspring of European x Canadian garden roses



Pedigree of Canadian cultivars (made using Pedimap)

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