

Design and realization of the multi-site *PeachRefPop* collection: an international research and breeding tool for fruit trees

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Abstract

Breeding of new varieties with improved resilience to environmental challenges will play a major role in adapting agricultural production to changing climatic conditions. Allelic diversity from germplasm collections is key to achieve this and coordinated efforts to establish multi-site

collections are needed to conserve genetic materials and dissect genotype-by-environment interactions. The lack of such resources is especially critical for perennial trees such as peach, a major fruit crop and recognized research model for the Rosaceae family. To fill this gap, we describe the rationale, design and construction of the first multi-site peach reference collection (*PeachRefPop: PRP*), with a shared experimental design replicated in five locations in Italy, Spain and Greece. Aiming to harness breeding history and genetic diversity represented in European collections, we took advantage of 1,262 accessions and 1,467 progenies from 18 crosses, previously genotyped for thousands of Single Nucleotide Polymorphisms distributed throughout the peach genome (<http://fruitbreedomics.com/>). In order to obtain a versatile resource suited to a range of purposes, we defined a multi-tier sampling strategy resulting in a final set of 150 accessions and 250 progenies for a total of 400 entries. While we took care to preserve the total number of alleles with the minimum number of accessions, we also used expert knowledge of peach breeding history to select additional materials covering phenotypic and geographic diversity. As supported by genetic analyses, composition of the *PRP* is highly representative of peach diversity present in European collections, harbouring all the allelic variability available within the starting panel, as well as representing specific genetic clusters and the most prominent phenotypic traits. Beyond providing an unprecedented platform for multi-environment genetic, genomic and breeding research in perennial species, the *PRP* launches an international collaborative effort for the conservation and exploitation of European peach germplasm as a legacy for future generations.