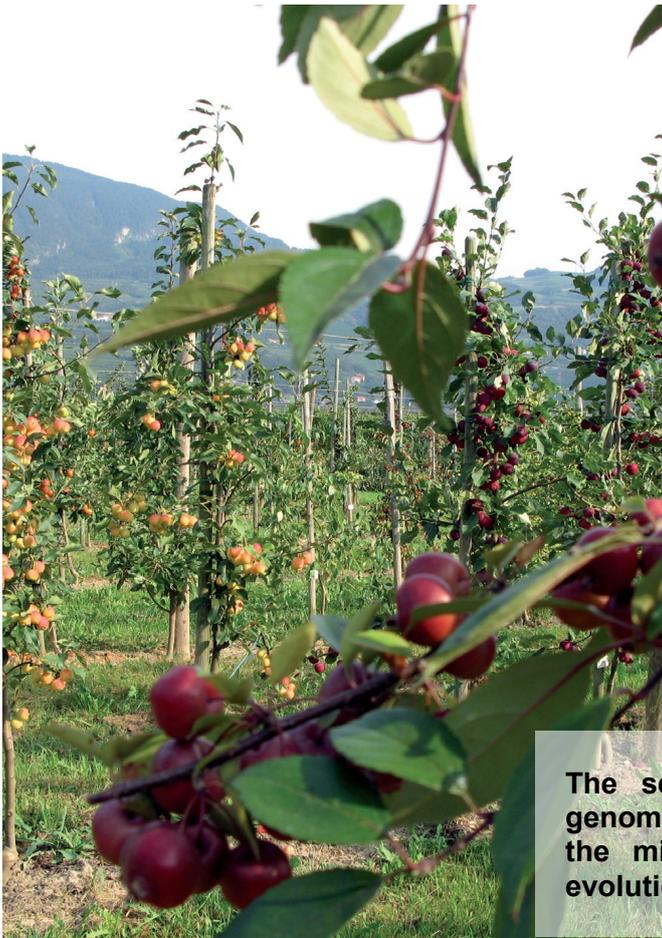


The origin of the apple



The origin of the genus *Malus* and the pome

The botanical term for the apple fruit is “pome” which defines the swelling of the flower receptacle. The pome is found only in apples and in close relatives such as the pear, rowan and quince. The appearance of the pome in this Rosaceae lineage is first detected ca. 50 mya. All species in this lineage display also 17 chromosomes, a rather peculiar number considering that all other Rosaceae species contain 7, 8 or 9 chromosomes. Analyses of the Golden delicious genome reveal a nearly perfect duplication of extant chromosomes. Based on this finding we can speculate that the current genome evolved from a progenitor species with 9 chromosomes which underwent a duplication followed by the loss of one chromosome. As such rearrangements occurred before the splitting of the apple lineage from pear, rowan and quince (all with 17 chromosomes); they must represent the basic events leading to the evolution of the pome.

The sequencing of the apple genome can contribute to unveil the misteries surrounding the evolution of this plant.

The molecular evidence we report in our study confirm current fossil evidence. The most ancient fossils attributable to species

similar to the modern Maloideae have been found in North America where a species with 9 chromosomes is still found today which could therefore be close to the ancient progenitor. From North America the progenitor with 17 chromosomes could have reached an Asian interglacial refuge through Beringia, the land-bridge once linking Asia and America and now covered by the Bering Sea. It is in Asia that the genus *Malus* evolves e differentiates in the over 50 species which we know today and that include the cultivated apple and wild species.

Malus sieversii, the only known wild apple species with large fruits (> 3 cm) is restricted to Tian Shan, a mountain region located between Kazakhstan and North West China. It is speculated that the evolution of the large fruit trait precedes cultivation by man and may have resulted from selective pressure exercised by seed dispersing animals such as horses and bears.

The origin of the cultivated apple

Based on archaeological and historical evidence, apple represents a relatively recent addition to the list of cultivated plants. Whilst cereals farming began 10-12000 years ago and coincided with the beginning of agriculture, apple cultivation appears much later, in the classical era. The first references to the apple are found in works by Homer, Alexander the Great and in the Bible although it is not clear how widespread was its cultivation. It is however certain that the apple was cultivated by Greeks and Romans. As propagation of apple plants by seed results in extreme dishomogeneity of the progeny with loss of favorable features and reappearance of wild traits successful apple cultivation requires the mastering of grafting techniques. Grafting was probably discovered in Asia (China?) around 4000 years ago and reached the Roman Empire through Syria. Reports of apple cultivation and of grafting applications appear simultaneously in the classical era. Studies by the great Russian botanist Vavilov in the 1930s and by Phils Forsline (at USDA, Cornell, USA) in the 1990s identified *M. sieversii* as the only wild species displaying all the characteristics found in modern cultivated apple. However, the observed promiscuity between cultivated and wild apple species raised also the possibility that other wild species (such as *M. sylvestris* in Europe) could have contributed to the evolution of the modern apple. Our studies unequivocally demonstrate that the cultivated apple, whilst undistinguishable from *M. sieversii*, it is clearly different from *M. sylvestris*. It is thus probable that genetic pool of modern apple was created through a process of “instantaneous domestication” involving repeated events of grafting of specimens of *M. sieversii* obtained from the natural orchards of Central Asia

