

Early flowering apple lines - new approaches to force apple breeding

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Breeding apple (*Malus x domestica* BORKH.), the world's most important temperate fruit crop, is limited due to a range of difficulties. Above-average time as well as money expenses to pyramid both resistance traits and fruit quality by hybridization arise from the long lasting juvenile phase before flowering initiates. A diversity of approaches to integrate resistance traits into cultivars within a reasonable time range was studied. In the last decade, transgenic early flowering apple plants were used to establish a fast track breeding system in apple. The introgression of *BpMADS4*, a *FRUITFULL*-like gene from silver birch (*Betula pendula*), as well as the down-regulation of the floral repressor *MdTFL1*, a homologue to *TFL1* from *Arabidopsis*, into apple cultivars led to early flowering and reduced the juvenile stage to a few months. However, the transgenic plants were characterized by an abnormal growth and continuous flower production resulting in an enormous fruit drop. Nevertheless, a breeding program based on the utilization of early flowering plants and marker-assisted selection was established using *Malus* species as resistance donors against diseases and pathogens. Due to several insufficiencies of the approach further research was focused on the utilization of an inducible promoter and other flowering inducing genes. Furthermore, in order to utilize the system in breeding it was necessary to integrate the flowering genes into different linkage groups, i.e. chromosomes.

An overview will be given on the state-of-the-art in developing a fast track breeding system for apple.

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