Apples: Harnessing Diversity for Genetic Improvement

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Apple have outstanding genetic diversity, from the 25 to 40 *Malus* species to the heterozygosity evident in every cross. The sequenced genome and many multi-disciplinary, cooperative research projects, such as RosBREED and FruitBreedomics, further our resources to effectively harness this diversity for genetic improvement. Research on transcription factors and promoters has furthered our knowledge of color in leaves, peel and flesh. Dihydrochalcones and their role in health has promoted detailed studies of germplasm and genetic pathways. Interspecific hybridization has targeted only a few of the many *Malus* species, most notably for disease resistance and for ornamental and rootstock breeding. Different *Malus* species crossed to a common columnar (or reduced branching) selection provides opportunities to study genetic background effects. These populations are excellent resources for summer intern research projects and they provide important insight into fruit set differences, leaf morphology, plant architecture and the occurrence of common off-types. Cultivar development has benefitted from enhanced knowledge of, and markers for, fruit quality traits. Future releases will offer consumers enhanced aroma, distinctive appearance and unique quality attributes. Maintaining consistency of quality across growing regions will remain a research challenge, since it requires efforts to minimize the variability inherent in apple. Opportunities abound!