

Jewels in the Genome

By Amy Iezzoni, Project Director

What is a “Jewel in the Genome?”

- An individual’s genome is the full complement of genetic information that it inherited from its parents. Within this vast repertoire of genetic information, individual genes are being discovered that control critical production and fruit quality traits. As these valuable rosaceous gene discoveries are made and put into breeding applications, we will describe them in this column as “Jewels in the Genome.”

Crisp, firm apples are highly desired by consumers as they have the much sought-after crunch when bitten into. However, making sure that consumers can enjoy these attributes is particularly challenging given the storage and transport required for most apples. Recently, genetic variation was discovered that helps differentiate whether apples will tend to be firm and crunchy or otherwise. The finding that this jewel is located on apple chromosome 10 led to the identification of a major gene that encodes the causal enzyme polygalacturonase. Polygalacturonase degrades fruit cell walls during ripening – resulting in apple softening and loss of the much sought-after crunchiness. This particular gene, *Md-PG1* (for *Malus × domestica* polygalacturonase), exhibits two variants in apple germplasm (Costa et al. 2010; Longhi et al. 2012). If an apple variety has one of the *Md-PG1* variants, common in older cultivars, the fruit tends to have accelerated loss of firmness after harvest compared to apple varieties that have the other *Md-PG1* variant. Breeding efficiency for apple eating quality can be increased by selecting for the desirable *Md-PG1* variant. Therefore, because *Md-PG1* will lead to the more efficient breeding of crunchy apples, it is chosen as one of RosBREED’s “Jewels in the Genome.”

However, selecting for *Md-PG1* should not be done without knowledge of some other apple loci that influence apple eating quality. These include [Md-ACS1, a major gene controlling apple texture](#), [Md-ACO1](#), and [Ma, a major gene influencing crispness](#). Therefore, *Md-PG1* represents the third jewel for the necklace of genes that impact apple texture and eating quality.

Costa F, Peace C, Stella S, Serra S, Musacchi S, Bazzani M, Sansavini S, van de Weg E. 2010. QTL dynamics for fruit firmness and softening around an ethylene-dependent polygalacturonase gene in apple (*Malus × domestica* Borkh.). *J Exp Bot* 61: 3029-3039.

Longhi S, Moretto M, Viola R, Velasco R, Costa F. 2012. Comprehensive QTL mapping survey dissects the complex fruit texture physiology in apple (*Malus × domestica* Borkh.). *J Exp Bot* 63:1107-1121.



Photo credit: David Hansen, University of Minnesota



Penetrometer measures firmness of apple flesh (Photo credit: David Hansen, University of Minnesota)



A consumer sensory panel evaluates the firmness and crispness of apples from the University of Minnesota breeding program (Photo credit: University of Minnesota).