

Breeder profile: Jim Luby

By Audrey M. Sebolt, project assistant



Jim Luby, University of Minnesota apple breeding program director.

Jim Luby is the current apple breeder at the University of Minnesota, which is one of the oldest breeding programs in the U.S, second possibly to Cornell University's apple breeding program. The program has essentially been running since 1878 and over its history has had five breeders, who together have released 27 apple cultivars. More than 75% of the cultivars grown in the state of Minnesota were developed by these breeders. Although Minnesota is ranked 24th for apple production in the U.S., the innovative contributions of these breeders to the apple industry are inspiring because they have developed trees that withstand the harsh winters of the Midwest and produce quality fruit enjoyed by North American consumers.

Today the strength of the breeding program continues to be exemplified by the flavorful and high quality cultivars that have been commercially released. One such cultivar, 'Honeycrisp', released in 1991, has been such a wide success that citizens of the state of Minnesota successfully petitioned that this cultivar be named the state fruit.



Due to their long generation time, breeding for orchard crops can take many years until a new cultivar is developed. For example, an initial cross was made in 1988 by Jim Luby and his assistant David Bedford, and after 10 years of evaluation, the original seedling was selected in 1999 to be released as Sweetango® apple (Minneiska cultivar). It was not until 2009 that the first commercial fruit from this cultivar were sold to the public.

Jim Luby began working for the University of Minnesota in 1982. In addition to breeding apples, Jim's program also breeds grapes, blueberries, and strawberries. He also collaborates with Dr. John Clark, another RosBREED demonstration breeder, in a project to develop primocane-fruiting blackberries (a type of blackberry that fruits on current-season canes) for the northern U.S. With such extensive commitments to the various breeding programs, Jim feels fortunate to have a dedicated and knowledgeable breeder, David Bedford, working with him. David has more than 30 years of apple breeding experience.



Jim Luby and David Bedford in the apple orchard determining which selections to make crosses

Jim and David manage an apple breeding program that has between 35 to 40 acres and more than 20,000 seedlings. These seedlings are located 30 miles west of the main campus at the Minnesota Agricultural Experiment Station's Horticultural Research Center. Located 200 miles north of the main campus is an additional test site where apple seedlings are tested for cold hardiness.

In the spring, Jim and David make crosses at the research station. Often, at least one of the parents is an advanced selection from their program. Other parents may be contemporary commercial cultivars, selections from other breeding programs, wild apple (*Malus sieversii*) from Central Asia USDA plant introductions, or heirloom cultivars with exotic names such as 'Pitmaston Pineapple', 'Alkmene' or 'Esopus Spitzenburg'. In a typical spring, 20 to 30 parental combinations are made with a target of producing 5,000 F₁ (first generation) seedlings. This

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target seedling number must be high as only 1 out of 10,000 seedlings actually becomes a cultivar that is commercially released.

During the fall, as many as 500 to 600 apple seedlings are evaluated each day for appearance, taste, and texture ([click here to see video](#)). Advanced selections are evaluated for numerous traits such as cold hardiness, acidity, skin color (amount of blush, hue, and stripes), firmness, juiciness, crispness, and reduced flesh browning to name a few! The apple breeding program also screens seedlings for disease resistance, primarily scab resistance.



Photo courtesy of David Hansen, University of Minnesota
David Bedford pollinating apples, University of Minnesota apple breeding program.

All of these traits combined ensure an exceptional cultivar, which is important for grower, industry, and consumer preferences. In regards to consumer preferences, Jim states that good appearance will achieve the first sale of an apple cultivar, but quality texture and excellent flavor will ensure a repeat sale. As to what exact appearance or shape of apple the public finds most appealing, Jim said, "That's a good question!" He hopes questions like this will be answered in the RosBREED's socio-economic team's consumer surveys and is looking forward to incorporating these results in his decision-making process.

Although marker-assisted breeding can increase the efficiency of breeding, we are not there yet. There is a chasm between genomics knowledge and its application via marker-assisted breeding. Currently, the University of Minnesota's apple breeding program is only using DNA markers for fingerprinting. For example, Jim's program used DNA markers to identify the true parentage of 'Honeycrisp'. It was originally believed that this variety was a hybrid of the apple cultivars 'Macoun' and 'Honeygold'. However, Jim, David, and other researchers (Cabe et al., 2005) found that 'Keepsake', another cultivar developed by the University of Minnesota's apple breeding program in 1978, is one of the parents of 'Honeycrisp', while the other parent has yet to be identified. The exact lineage of 'Honeycrisp' may be elucidated using cutting-edge software (FlexQTL™) that will be made available to RosBREED's demonstration breeders. In RosBREED, founding clones for breeding programs as well as advanced selections will be genotyped and, through a process called "identity by descent," the other parent and its genetic origin may be discovered. Jim's program is also working towards defining locations in the genome that control fruit texture, such as the explosive crispness of 'Honeycrisp'.

Jim is a demonstration breeder for RosBREED. This means he is one of the 12 breeders who will be the first to test the software and breeding tools developed by RosBREED. Jim, in addition to being the apple crop team leader, is the breeding team leader for RosBREED. His responsibilities include organizing the 12 RosBREED demonstration breeders so that uniform phenotyping protocols are developed, ensuring that critical deadlines are set and kept, and ensuring that the breeders contribute to and understand the new technologies being developed and used by RosBREED.

Jim hopes that the successes of RosBREED will enable his breeding program to routinely screen parental selections with DNA markers for texture as well as other important economic traits. He is also hopeful that seedlings from crosses will be screened for critical markers early during their juvenile phase to eliminate those that will likely have inferior fruit quality.

Reference

Cabe, P.R, A. Baumgarten, K. Onan, J.J. Luby, and D.S. Bedford. 2005. Using microsatellite analysis to verify breeding records: a study of 'Honeycrisp' and other cold-hardy apple cultivars. HortScience 40:15-17.