100 Years of Fruit Crops Breeding at the University of Minnesota

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The University of Minnesota Horticultural Research Center is home to of the oldest, continuous fruit breeding programs in North America. We develop fruit cultivars that are adapted to the vagaries of the continental climate of our region - temperatures that range from 100 F in the summer to -40 F in the winter and precipitation that can vary dramatically from year to year.

The University of Minnesota fruit breeding program was initiated in 1878 as a response to the settlers need for sources of fresh, canned, and dried fruits to provide essential variety and nutrition in their diet. The breeding program was charged with developing winter hardy fruit varieties that they could produce reliably on their farmsteads. As a result over 100 cultivars of apples, plums, grapes, strawberries, raspberries and other fruits were introduced since the 1920s (Table 1).

As 19th century settlers on the northern Great Plains discovered, this region was one of the most inhospitable of any in the young nation for fruit production. Through the early 20th century this was a region with hundreds of thousands of small farms. The fruit from the farm orchard was eaten fresh in the summer, canned or dried for the winter, or used for fermented beverages. Sometimes fruit provided additional income. More importantly, it provided critical nutritional components, as well as delight, in a sometimes bland and monotonous diet. When the new farmers of the region realized that many fruit cultivars they brought from the eastern U.S. or from their native regions of Europe failed in the harsh winters and droughty summers of the continental climate. Consequently, they organized into state horticultural societies that developed lists of recommended varieties based on members' experiences and also identified needs for cultivar development. Members of the Minnesota State Horticultural Society encouraged their legislature to address the critical lack of adapted fruit varieties by establishing a fruit breeding programs at the University of Minnesota.

Minnesota

The initiation of fruit breeding at the University of Minnesota was due in large measure to success of the colorful and controversial Peter M. Gideon in developing the first great apple variety from the northern plains. Gideon had arrived in Minnesota in 1853 with many fruit trees to test and a bushel of apple seeds to plant. By 1868, he had identified an outstanding seedling, eventually named the 'Wealthy' apple after his wife, which became one of the most important cultivars in the United States by the late 1800s and early 1900s. Indeed, it was primarily due to his success in developing and commercializing 'Wealthy' that the state legislature agreed to fund a breeding program.

Fruit breeding at the University of Minnesota has been ongoing since 1878 when the legislature of the 20-year-young state appropriated the grand sum of $2000 to purchase a tract of land as an experiment station and $1000 per year for operations. Gideon was named the first superintendent of the new station, located near his farm on Lake Minnetonka at Excelsior, Minnesota. Unfortunately, Peter Gideon and University administrators had their differences. Gideon felt that he was not given appropriate support or recognition while university administrators thought the he operated the station too independently. Gideon directed the program until 1889 when he retired at age 70 and the station was abandoned. A later University of Minnesota fruit breeder, William Alderman, noted that the mere 10 years that 'the Minnetonka Fruit Farm' was open was too short for productive results. He lamented the politics of the day but lauded Gideon: "It is unfortunate that clashing personalities prevented him from assuming a more constructive leadership in the great fruit breeding program that was to develop through the

region. Be that as it may, he still must be recognized as the 'father of fruit breeding on the prairies'" (Alderman, 1962).

While Peter Gideon managed the program in Excelsior, Samuel B. Green, the first professor of horticulture at the University of Minnesota, began crossing apples in 1888 and grew the seedlings at the University Farm in St. Paul which has now become the University of Minnesota St. Paul campus. Green spent some time evaluating apples but eventually became more interested in forest management as the great pine forests of northern Minnesota were being cut and is now honored as the father of modern forestry in Minnesota.

In 1907, the legislature appropriated $16,000 to purchase land to establish a new fruit breeding farm between Excelsior and Chaska, about 33 miles southwest of Minneapolis-St. Paul. This farm, expanded by several other land acquisitions in subsequent decades, became today's Horticultural Research Center and was the center of fruit breeding for the next century. The farm was continually staffed with a superintendent and knowledgeable horticultural technicians who took active roles in the fruit breeding. Through the early twentieth century several faculty taught on the St. Paul campus and then in the summer traveled to the Fruit Breeding Farm by streetcar to conduct fruit breeding research. Usually they would stay in one of several cabins at the farm, even bringing their families, thus using it as their summer research retreat.

Through the twentieth century, numerous scientists were involved in fruit breeding. A tradition, established during the long leadership of William H. Alderman was to encourage recognition of the program rather than individuals. The superintendent of the Fruit Breeding Farm was a key position in early times when transportation from campus was more difficult. Charles Haralson, was appointed as the first superintendent. Haralson had been an assistant to Nils Hansen, the fruit breeder at South Dakota State College, and was honored with the naming of the 'Haralson' apple which became the most important cultivar in Minnesota for several decades. Other notable assistant superintendents and technicians who were actively involved in the fruit breeding efforts included Frederick Haralson, Patrick Pierquet and Elmer Swenson. Although he spent a short time at the University of Minnesota, Swenson was especially known for his independent grape breeding efforts. He began breeding grapes on his western Wisconsin dairy farm after World War II. A gentle, humble man, and carefully self-educated plant breeder, he made great progress in developing hardy grape hybrids based on the local riverbank grape, *Vitis riparia*, crossed with French and American hybrids. His legacy continues with germplasm used in the program at the University of Minnesota.

Several University of Minnesota faculty provided leadership to the fruit breeding programs (Snyder, 1982). Following the death of Samuel Green in 1910, M.J. Dorsey was named Associate Professor of fruit breeding on the St. Paul campus and served until 1921. Other faculty involved in the fruit breeding through the twentieth century included W.H. Alderman (1919-1953), J.H. Beaumont (1919-1928), A.N. Wilcox from 1923-1963, T.S. Weir (1939-1966) and William Anderson (1964-1966). Over 100 fruit cultivars were introduced, beginning in the 1920s. During the early decades, introductions were focused on apples, plums and related *Prunus,* as well as small fruits. Several introductions became regionally, nationally or even internationally popular. The 'Latham' raspberry, for example, propelled Minnesota to be the third ranked state in the U.S. in raspberry acreage by the 1940s with a crop value of over a million dollars annually. It became widely grown in eastern North America and colder parts of Europe. 'Trumpeter' strawberry and 'Haralson' and 'Beacon' apples became regional favorites. The 'North Star' and 'Meteor' tart cherries and the 'Red Lake' currant were widely grown in North America and Europe. 'Sungold' and 'Moongold' apricots, 'Parker' pear, and a host of plums remain regionally popular to this day in home landscapes and gardens.

Cecil Stushnoff led the program from 1967-1980. Though he maintained a large emphasis on apples, his experience as a graduate student in New Jersey also inspired an attempt to develop large-fruited, productive blueberries for cold climates. This led to a string of winter hardy half-high to ¾-high cultivars that allowed a commercial direct-market blueberry production

in USDA hardiness Zones 4 and 3. 'Northblue' and, more recently, 'Chippewa' and 'Polaris' have become the most popular commercial cultivars.

In the late 20th and early 21st centuries, the breeding program has focused on apple, grape, blueberry and strawberry breeding. James Luby has overseen the fruit breeding program since 1982 along with David Bedford, in apple breeding, David Wildung (retired 2007) in berry breeding, and Peter Hemstad, who invigorated the grape breeding effort in 1985. This period has been marked by the introduction of 'Honeycrisp', the first apple introduction from the program to gain world-wide interest, 'Mesabi' strawberry, and 'Frontenac', 'La Crescent' and 'Marquette', the first high quality wine grapes from the program. A new series of high-quality, disease resistant, hardy strawberries is also being introduced from a cooperative breeding program that began in 1980 with Dr. David Wildung at the University of Minnesota and Dr. Gene Galletta at the USDA-ARS Fruit Laboratory in Beltsville, MD.

Today, the fruit breeding program remains comprehensive with substantial efforts to develop commercial varieties of apple, grape, strawberry, blackberry and blueberry. Our goal is to develop winterhardy, disease resistant cultivars that bear high quality fruit at commercially profitable levels in our region. The germplasm developed over the previous 100 years serves as a critical genetic base as our breeding tools expand from forcepts, tags, bags and Petri plates of pollen to include DNA markers and other genomic tools.

Alderman, W.H. 1962. Development of Horticulture on the Northern Great Plains. The Great Plains Region American Society for Horticultural Science.

Alderman, W.H., A.N. Wilcox and T.S. Weir. 1957. Fruit varieties developed at the University of Minnesota Fruit Breeding Farm. University of Minnesota Agric. Expt. Station Bulletin 441.

Snyder, L.C. 1982. History of the Department of Horticultural Science and Landscape Architecture 1849-1982. Minnesota Agricultural Experiment Station, St. Paul, MN.

Table 1. Fruit cultivars introduced by the University of Minnesota fruit breeding program.				
Cultivar name (and associated trademarks)	**Year introduced**	**MN selection number**	**Parentage**	**Features**
Apple (*Malus pumila*)				
Beacon	1936	423	Malinda OP	Early fall, hardy, bright red
Fireside	1943	993	Unknown	Sweet late season apple
Folwell	1922	237	OP from seedling of Malinda OP	Very large fruit
Haralson	1922	90	Malinda x Wealthy	Tart, good for culinary
Honeycrisp	1991	1711	Putatively Keepsake x unknown	Exceptionally crisp and juicy, well-balanced flavor, good storage
Honeygold	1966	1595	Golden Delicious x Haralson	Late fall, sweet, crisp, yellow
Keepsake	1978	1593	MN 447 x Northern Spy	Winter, long storage life
Lakeland	1950	978	Malinda OP	Fall, culinary
Minjon	1942	700	Unknown (possibly Jonathan x Wealthy)	Fall culinary (applesauce), red
Minnehaha	1920	300	Malinda OP	Red, winter apple
Oriole	1949	714	Unknown	Summer, striped, tart
Prairie Spy	1940	1007	Unknown	Winter, culinary
Red Baron	1970	1500	Golden Delicious x Daniel's Red Duchess	Fall, red sweet
Redwell	1946	638	Scotts Winter OP	Late fall, hardy, red
Regent	1964	1430	Daniel's Red Duchess x Delicious	Winter, red, high-quality eating
State Fair	1977	1639	Mantet x Oriole	Early fall, red, tart
Sweet Sixteen	1977	1630	MN 447 x Northern Spy	Midseason, sweet, unusual flavor
Victory	1943	396	McIntosh OP	McIntosh flavor, white flesh
Wedge	1922	207	Ben Davis OP	Very hardy, very large fruit for cooking
Wildung (SnowSweet® apple)	2006	1797	Connell Red x Sharon	Late season sweet rich flavor
Minnewashta (Zestar!® apple)	1996	1824	State Fair x MN 1691	Early season, very flavorful and juicy
Frostbite™ apple	2008	447	Unknown	Exotic tropical fruit flavor

Crabapple (*Malus* spp.)				
Centennial	1957	1472	Dolgo x Wealthy	Early fall, very hardy, good flavor
Chestnut	1946	240	Malinda OP	Fall, excellent flavor, dense texture
Flame	1934	635	Unknown	Pyramidal ornamental, flaming red fruits
Northland	1957	1423	McIntosh x Dolgo	
Apricot				
Moongold	1960	15	Superb x Manchu	Hardy, golden yellow
Sungold	1960	36	Superb x Manchu	Hardy, yellow with red blush
Almond-Peach Hybrid (*Prunus* spp.)				
Manitou	1923	7	*Prunus nana* Stokes x Bokara peach	Pink flowers, sterile
Blueberry (*Vaccinium* spp.)				
Chippewa	1996	393	B18A x US3	¾ high with sweet light blue berries
Northblue	1983	360	B10 x US3	Half-high habit, large fruit, high yield
Northsky	1983	332	B6 x R2P4	Low-growing habit
Northcountry	1986	350	B6 x R2P4	Medium-low growing, excellent flavor
Polaris	1996	408	B15 x Bluetta	Highly aromatic, firm berries
St. Cloud	1990	167	B19A x US 3	Highbush habit, good yield
Superior	2008	5451	Unknown	Late-season, good Zone 3 performance
Cherry, Tart (*Prunus cerasus*)				
Meteor	1952	66	Montmorency x Vladimir	Hardy, pie cherry
Northstar	1950	58	English Morello x Serbian Pie 1	Hardy, semi-dwarf, pie cherry
Cherry, Nanking (*Prunus tomentosa*)				
Orient	1949	63	Seedling from selfing of unnamed selection	Self-fertile
Cherry-Plum (*Prunus* spp.)				
Deep Purple	1965	440	Sioux (*P. besseyi*) x Elephant Heart plum	Deep purple color

Nicollet	1925	144	Possibly (*P. avium* x *P. pennsylvanica*) x *P. besseyi*	Fruit resembles sour cherry
St. Anthony	1923	145	*P. besseyi* x Satsuma plum	Dark red flesh
Zumbra	1920	--	Possibly (*P. avium* x *P. pennsylvanica*) x *P. besseyi*	Good for sauce
Currant (*Ribes rubrum*)				
Cascade	1942	70	Diploma OP	Large berries
Red Lake	1933	24	Unknown	Large cluster of medium fruit, red
Gooseberry (*Ribes* spp.)				
Como	1921	43	Pearl x Columbus	Very productive
Welcome	1957	206	Poorman OP	Large fruit
Grape (*Vitis* spp.)				
Bluebell	1944	158	Unknown	Hardy, early maturing, juice grape
Blue Jay	1944	69	Unknown	Hardy, pistillate, blue Concord-type
Edelweiss	1977	ES 40	MN 78 x Ontario	White table grape, disease resistant, joint introduction with Elmer Swenson
Frontenac	1995	1047	*V. riparia* #89 (Jordan, MN) x Landot 4511	Hardy disease resistant red wine grape
Moonbeam	1944	66	Unknown	Very large, white fruit
Red Amber	1944	45	Unknown	Hardy, vigorous red grape
Swenson Red	1977	ES 439	MN 78 x Seibel 11803	red table grape, crisp flesh, joint introduction with Elmer Swenson
La Crescent	2002	1166	St. Pepin x ES 6-8-25 (*V. riparia* x Muscat Hamburg)	Aromatic, white wine grap
Frontenac gris	2003	1187	Frontenac sport	Grey sport of Frontenac for white or blush wine
Marquette	2006	1211	MN 1094 x Ravat 262	Red wine grape with complex flavor
Pear (*Pyrus* spp.)				
Bantam	1940	3	Unknown	Small fruit, fireblight resistant
Golden Spice	1949	4	Unknown	Very hardy, tart, spicy flavor

Parker	1934	1	Unknown	Large fruit, good quality, possibly same as Flemish Beauty
Summercrisp	1986	N33201	Unknown	Early, medium-size fruit, crisp skin
Plum (*Prunus* spp.)				
Alderman	1986	416	Burbank (*P. salicina*) x Older	Large fruit, firm skin
Anoka	1922	118	Burbank (*P. salicina*) x De Soto	Only fair quality
Elliot	1920	8	Probably Apple x *P. americana* Marsh	Good quality fruit, but only medium vigor
Ember	1936	83	Shiro (*P. salicina* hybrid) x SD 33 (*P. americana*)	Excellent quality, hangs on tree
Goldenrod	1923	120	Shiro (*P. salicina* hybrid) x Howard Yellow (*P. americana*)	Large, firm-fleshed yellow plum, unproductive
Hennepin	1923	132	Satsuma (*P. salicina*) x unknown *P. americana*	Hardy, productive, red flesh
La Crescent	1923	109	Shiro (*P. salicina* hybrid) x Howard Yellow (*P. americana*)	yellow plum, sweet, tender skin
Mendota	1924	5	Burbank (*P. salicina*) x Wolf (*P. americana*)	Very large, attractive, lacks vigor
Monitor	1920	70	Burbank (*P. salicina*) x *P. americana*	Hardy, very productive
Mound	1922	50	Burbank (*P. salicina*) x Wolf (*P. americana*)	Very productive, only fair quality
Newport	1923	116	Omaha (*P. salicina x P. americana*)x *P. pissardi*	Hardy, red-leaved ornamental
Radisson	1925	157	*P. salicina x P. americana*	Very early
Redcoat	1942	17	Burbank (*P. salicina*) x Wolf (*P. americana*)	Productive, freestone
Redglow	1949	101	Burbank (*P. salicina*) x Jewell (*P. salicina x P. munsoniana*)	Reliable production and good keeping
Red Wing	1920	12	Burbank (*P. salicina*) x Wolf (*P. americana*)	Large size, free stone, susc. to leaf spot
Pipestone	1942	218	Burbank (*P. salicina*) x (Burbank x Wolf (*P. americana*))	Large red fruit, juicy
South Dakota	1949	SD 27	*P. americana*	Seedling of native *P. americana* (for pollination), joint intro with SD
Superior	1933	194	Burbank x Kaga (*P. americana x P. simonii*)	Large fruit, very productive
Tonka	1920	21	Burbank (*P. salicina*) x Wolf (*P. americana*)	Productive but short lived trees
Underwood	1920	91	Shiro (*P. salicina* hybrid) x Wyant (*P. americana*)	Early ripening, good flavor

Waconia	1923	10	Burbank (*P. salicina*) x Wolf (*P. americana*)	Productive, only fair quality
Winona	1922	30	Probably Abundance (*P. salicina*) x Wolf (*P. americana*)	Large, late ripening, brown rot susceptible
Raspberry (*Rubus idaeus*)				
Chief	1930	223	Latham selfed	Firm, hardy, hard to pick
Latham	1920	4	King x Louden	Large fruit, productive, red variety
Itasca	1965	399	Newburgh selfed	
Nordic	1988	603	Heritage x Fallred	Hardy, productive, small fruit
Redwing	1988	629	Boyne x Fallred	Early Fall bearing, productive
Strawberry – Everbearing (*Fragaria ananassa*)				
Deephaven	1921	41	Probably Dunlap x Progressive	Susceptible to virus
Duluth	1920	1017	Dunlap x Pan American	Large, vigorous, winterhardy plants
Evermore	1945	1166	Duluth x Dunlap	Performed well on Great Plains
Strawberry – Junebearing (*Fragaria ananassa*)				
Arrowhead	1946	1118	Duluth x Dunlap	Vigorous, hardy
Burgundy	1943	1192	Easypicker x Duluth	Pistillate, late ripening
Chaska	1922	801	Brandywine x (Pocomoke x Dunlap)	Large-fruited, attractive
Earlimore	1958	1636	Campbell S_1 x Howard 17	Early, productive
Easypicker	1922	775	Crescent x Dunlap	Pistillate, excellent quality, easy to pick
MNUS 138 (Itasca™)	2006	MNUS 138	Seneca x Allstar	Early season, productive
MNUS 248 (Mesabi™)	1999	MNUS 248	Glooscap x MNUS 99	Very productive, creamy texture
Minnehaha	1920	935	Abington x Minnesota	Large size and shipping quality, poor color
Minnesota	1920	3	Pocomoke x Dunlap	Productive but afflicted with June-Yellows
Nokomis	1921	489	Abington x Dunlap	Productive with soft fruit
Northland	1981	1868	Burgundy x Premier	June-bearing, hardy for northern MN, zone 3
Trumpeter	1960	--	Burgundy x Howard 17 S_1	June-bearing hardy
MNUS 210 (Winona™)	1996	MNUS 210	Earliglow x MNUS52(Lateglow x MDUS 4616)	Late season Junebearing, large, flavorful berries, disease-resistant plants

Apple Breeding Timeline

Year 1 Plan and make crosses in field
Year 2 Plant seeds in greenhouse; Bud graft in July-Aug onto B9 rootstock in seedling orchard (Some seedlings may be screened in greenhouse for apple scab)
Year 3 Training of seedling trees
Year 4-6 culling of seedlings in field for fire blight susceptibility, winter injury, poor growth
Year 5-10 Evaluate seedlings for tree characters and fruit quality as they begin to fruit (First Test); Propagate selections by bud grafting on M26 and B9 rootstock.
Year 7-11 Plant 4 trees of each selection in observation trials (Second Test) at Excelsior; some also go to Grand Rapids for hardiness testing
Year 11-15 Evaluate fruit from observation trials (including more extensive post harvest evaluation); Send best selections to other sites for evaluation; Propagate best selections for commercial test nationally may use multiple rootstocks. Identify selection(s) for introduction
Year 16-19 Virus indexing and heat treatment (if necessary) for virus elimination. Initial field propagation by nurseries. Send virus indexed material for international testing.
Year 20 Substantial stock available to apple growers
Year 25 First substantial amount of fruit available in markets