Historic American Apple Cultivars: Identification and Availability

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ABSTRACT. Apples (*Malus* Mill.) have been economically and socially important throughout the centuries in North America. Apple cultivar (*Malus* × *domestica* Borkh.) collections that include historic cultivars are valued for their unique diversity, historical significance, and also as a resource to identify unknown trees; however, not all of the historically significant apple cultivars are currently included in these collections. We used historic books, publications, and nursery catalogs to develop an inventory of apple cultivars that were propagated and grown in the United States before 1908. We collected synonym, introduction date, and original source country information for 891 historic apple cultivars. Most of the historic American cultivars originated as seedlings first planted in the United States. Some cultivars were brought to the United States from the United Kingdom, France, Russia, Germany, and other European countries. We classified historic apple cultivars based on their availability over time and popularity in nursery catalogs. Ninety percent of the most popular historic apple cultivars in the United States were available in 2015 in the U.S. and U.K. national collections and within several commercial and private collections. This work identified high priority historic cultivars that are not currently protected within genebanks that could be added to genebank collections in the future.

“It is remarkable how closely the history of the Apple-tree is connected with that of man.” (Thoreau, 1913)

Apple has been a mainstay of American culture for centuries (Burford, 2013). Wild *Malus* sp. are native to North America as well as Europe and Asia (Volk et al., 2015). The wild apple species of North America [*Malus fusca* (Raf.) C.K. Schneid., *Malus angustifolia* (Aiton) Michx., *Malus coronaria* (L.) Mill., and *Malus ioensis* (Alph. Wood) Britton] were traditionally used by Native Americans for food, medicinal purposes, tools, fuel, and shelter (Turner and Hebda, 1990; Turner and Turner, 2008; Yanovsky, 1936). Europeans brought seeds, scionwood, or trees of their local apple cultivars with them to North America during the colonial era (Dolan, 2009). The grafted trees that originated from the European scions were genetically identical to those in Europe, and thus their cultivar names were retained (Dolan, 2009).

Seeds brought from Europe were planted and grew into seedling trees, which were not identical to their original European sources. Seeds were from open-pollinated crosses, resulting in recombination events which revealed new genetic combinations of inherited traits (Dolan, 2009). Early colonists collected seeds from apple trees and planted them widely (Dolan, 2009; Morgan and Richards, 1993). The planting of seedlings was encouraged, as apple trees provided both food and beverage to new settlers on their homesteads (Hokanson et al., 1997). Sometimes, specific desirable trees were identified from these seedling populations and were subsequently clonally propagated, distributed, and planted. New cultivars

with physiological traits adapted to regional climates were identified (Diamond, 2010; Dolan, 2009). Some of the earliest named apple cultivars originating in the United States were High Top Sweet, Roxbury Russet, and Rhode Island Greening, all dating from the early to mid-1600s (Smith, 1971).

In colonial times, apples were valued for their use in hard cider production perhaps more so than for their value as dessert or cooking apples (Juniper and Mabblerley, 2006). People vary in their preference for apple fruit sweetness, acidity, juiciness, and crispness (Bonany et al., 2014; Harker et al., 2003), and traits such as flavor and crispness are the most important traits rated by producers for successful apple cultivars (Yue et al., 2013). Historic apple cultivars differ in their fruit trait characteristics and offer novelty to the marketplace. Novel cultivars, whether heirloom or new, attract markets that make fruit production profitable (Yue and Tong, 2011).

“I love better to go through the old orchards of ungrafted apple-trees, at whatever season of the year,—so irregularly planted: sometimes two trees standing close together; and the rows so devious that you would think that they not only had grown while the owner was sleeping, but had been set out by him in a somnambulant state.” (Thoreau, 1913)

A recent resurgence in appreciation for heritage fruits and vegetables has brought about an interest in historic apple cultivars that were once valued for cider, fresh consumption, and processing (Hansen, 2010). There is a growing segment of the population that chooses to plant and consume heirloom fruits and vegetables (Grassbaugh et al., 2004; Merwin 2008). Although many historic fruit cultivars have been identified and are available, the search for additional historic fruit cultivars continues (Veteto and Carlson, 2014). Heirloom fruit can be found in fruit growing regions at local farmer’s markets and in many backyards (Goland and Bauer, 2004; Merwin, 2008).

The interest in historic apple cultivars is from both cultural and historical perspectives as federal (national parks and

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monuments), state, and private landholders seek to learn more about local historic fruit trees (Routson et al., 2009). In some cases, original apple trees from the late 1800s may still be alive, but cultivar identity documentation has often been lost. Increasingly, there is an interest in identifying the cultivars represented by historic fruit trees (Routson et al., 2009). To identify unknown trees, it is necessary to have authentic apple cultivars available for phenotypic and genetic comparisons (Routson et al., 2009).

The U.S. Department of Agriculture (USDA), Agricultural Research Service National Plant Germplasm System (NPGS) maintains one of the largest, most diverse *ex situ* apple collections in the world (Volk et al., 2015). *Malus ×domestica* cultivars (1473 accessions), as well as thousands of individuals representing hybrids and wild species, are maintained in the field collection of the Plant Genetic Resources Unit (PGRU) in Geneva, NY (Volk et al., 2015). Given the maintenance costs and space limitations, genebank collections cannot conserve every cultivar that has ever been named or described (van Treuren et al., 2009, 2010; Volk et al., 2015). Consequently, the focus of the NPGS collection is to conserve genetic diversity, in the forms of alleles, genotypes, and specific traits, as well as cultivars that are of key interest to apple breeding and research programs (Volk et al., 2015; Walters et al., 2008). It is a challenge for genebanks to determine the authenticity and novelty of their holdings (van de Wouw et al., 2011).

Apple is often cited as a prominent example of crop genetic erosion in the United States based on the large number of named cultivars recorded historically compared with those currently available (Fowler and Mooney, 1990). Etymological variation in cultivar names does not necessarily correspond strongly to genetic variation and identity (Bellon and Brush, 1994; Jarvis et al., 2008; Quiros et al., 1990; Sadiki et al., 2007). Nonetheless, without the means for genetically analyzing currently unavailable cultivars, the historical records of cultivar existence provide a valuable indication of the extent of historical cultivar availability (Börjeson, 2015; Mack, 1991; Pincetl et al., 2013), and can provide some rough index, within very broad limits, of the relative quantity of cultivar diversity currently available relative to that in historical eras (Solberg and Breian, 2015). The presence of cultivar listings in historical records can serve as a potentially useful tool for gauging the historical importance of such cultivars (Börjeson, 2015; Zeven and Brandenburg, 1986). This follows from the assumption that, if a cultivar is recorded historically many times, then it was more widely grown and may have met many horticultural needs and yielded valuable products, and thus possessed important genetic traits. Conversely, if a cultivar name is recorded once or only a few times, perhaps it was not cultivated widely or for very long, and therefore was less important agronomically or as a source of genetic diversity. Therefore, cultivars that were frequently mentioned throughout long periods of the historical record would be assigned the highest priorities for conservation in genebanks and those recorded rarely during brief period would have lesser priority.

Recognizing a need for access to key historical apple cultivars in genebanks, we used books and nursery catalogs to identify historically significant apple cultivars in the United States. We then developed criteria to classify these cultivars based on their popularity and longevity, and queried apple

collection inventories to obtain information about cultivar availability in 2015.

Materials and Methods

Cultivar inventories were compiled primarily from books and historic nursery catalogs. Information for apple cultivars from early American eras (1600s to 1830) was gathered from books (Chappell, 2000; Hatch, 1998; Morgan and Richards, 1993) as well as historic references that were downloaded from online sources, including the National Agricultural Library (Supplemental Table 1). Ten references provided information for the period from 1736 to 1810 (with between 14 and 102 cultivars listed in each). Apple cultivar listings for the mid-1800s (1830 to 1869) were compiled from four source books [with between 11 and 122 cultivars listed in each (Supplemental Table 1)].

Forty-nine nursery catalogs that advertised apple cultivars dating between 1870 and 1907 (between 11 and 129 cultivars listed in each) were downloaded from online sources, including the National Agricultural Library (Supplemental Table 1). Two additional books provided information across the eras (Morgan and Richards, 1993; Warder, 1867). A comprehensive book “Nomenclature of the apple: A catalogue of the known cultivars referred to in American publications from 1804 to 1904” (Ragan, 1905) was used to determine, which apple cultivars were present in the United States within that time period but had originated from other countries.

Apple cultivars in the compiled lists were cross referenced to identify synonyms according to the National Fruit Collection, Brodgate, UK (NFC, 2015), Smith (1971), Calhoun (2010), and historic nursery catalogs (Supplemental Table 1), and standardized names were recorded for the identified synonyms. Many additional synonyms exist for cultivars, but our work focused on standardizing names that were recorded in the surveyed literature rather than documenting all known synonyms for apple cultivars.

The NPGS online database Germplasm Resources Information Network (USDA, 2015) was queried using standardized names and historic synonyms to assess collection availability for apple cultivars. For accessions not available in the NPGS, the NFC database was queried (NFC, 2015). For cultivars that were not available in either collection, the inventory of the Temperate Orchard Conservancy, Molalla, OR (Temperate Orchard Conservancy, 2016), the cultivar list provided in Veteto and Carlson (2014), that available for Tower Hill Botanic Garden (Boylston, MA), as well as commercial nurseries (Albemarle CiderWorks, North Garden, VA; Greenmantle Nursery, Garberville, CA; Kuffel Creek Apple Tree Nursery, Riverside, CA; Salt Spring Apple Co., Salt Spring Island, BC, Canada; Urban Homestead, Bristol, VA) were queried.

Original introduction dates and source countries for each apple cultivar were gathered from Smith (1971), USDA (2015), and Calhoun (2010). For each cultivar, the earliest documented date was recorded. Data for the most recent recorded date of each cultivar were gathered from Smith (1971), from the most recent reference in the historical literature, or was recorded as 2015 for materials that were in the inventories of the NPGS, NFC, or available from commercial or nonprofit organizations. Cultivar durations were calculated by subtracting the earliest documented date from the date of the most recent documented occurrence of each cultivar.

The apple cultivars inventoried in this work were categorized according to introduction dates based on published records. The categories were early [EARLY (before 1830)], mid-1800s [MID (1830–69)], and century [CEN (1870–1907)]. These ranges were established based on gaps in time for which source information that was available. The earliest recorded introduction date was the basis for the first categorization factor (EARLY, MID, and CEN). If the cultivar was subsequently mentioned in literature in another time period, the second (or third) descriptor name was added to the first classification. For example, if a cultivar was documented pre-1830, and then subsequently documented in the mid-1800s, it was listed as EARLY-MID. If this same cultivar was also listed in a 1900 nursery catalog, it was classified as EARLY-MID-CEN. If a cultivar was first listed as MID, and was also listed in the 1900 nursery catalog, it was classified as MID-CEN.

The American Pomological Society (APS) was a society of pomologists with some members who were experts in apple

cultivation. APS membership provided recommendations in 1905 based on experience with “practical growers who have tested them in various sections of the country.” APS sent inquiries to fruit growers for feedback on cultivars with desirable qualities. It was noted that some growers considered only fruit quality in their responses, whereas others considered tree hardiness, fruitfulness under varying conditions, and commercial value. Responses were compiled and published (Ragan, 1909). We appended the abbreviation “-APS” after the time period categorization of the cultivar (or a synonym for that cultivar) was listed in the 1909 APS published recommendations. Cultivars that were listed in the APS publication (Ragan, 1909), but not found in the surveyed literature, were listed as “APS” in our classification system.

Longevity and popularity were used as criteria to classify each apple cultivar. Category 1 cultivars were defined as those that were present in at least 10 of the 49 nursery catalogs dated between 1888 and 1907. The EARLY-MID-CEN and

Table 1. Number of historic American apple cultivars classified according to introduction date EARLY (before 1830), MID (1830–69), or CEN (1870–1907). American Pomological Society (APS) designation indicates if the cultivar (or a synonym) is listed as recommended by APS in 1909. The rightmost column indicates the number of apple cultivars in each category that were listed in 10 or more catalogs (of the 49 surveyed) between 1888 and 1907.

Category	Cultivars (no.)				
	Not in APS (1909)	In APS (1909)	Only APS (1909)	Total	10 + catalogs (1888–1907)
EARLY	163	7		170	51
EARLY-MID	38	13		51	0
EARLY-MID-CEN	25	79		104	31
MID	272	14	17	303	0
MID-CEN	15	69		84	0
CEN	82	41	56	179	11
Total	595	223	73	891	93

Table 2. Availability of historic apple cultivars in 2015 presented by both number (A) and percent (B). The sources were queried in the following order to determine availability: U.S. Department of Agriculture, Agricultural Research Service National Plant Germplasm System (NPGS); National Fruit Collection (NFC, Brodgate, UK); Temperate Orchard Conservancy (TOC, Molalla, OR); commercial sources [Tower Hill Botanic Garden (Boylston, MA), Greenmantle Nursery (Garberville, CA), Urban Homestead (Bristol, VA), Kuffel Creek Apple Tree Nursery (Riverside, CA), Albemarle CiderWorks (North Garden, VA), Salt Spring Apple Co. (Salt Spring Island, BC, Canada)]; and Veteto and Carlson (2014).

A	Cultivars (no.)						
	Total	NPGS	NFC	TOC	Commercial	Veteto and Carlson (2014)	Total available
Category 1 ^z	150	84	16	31	2	2	135
Category 2 ^y	101	25	12	24	3	2	66
Category 3 ^x	51	10	6	12			28
Category 4 ^w	589	39	22	60	3	6	130
B	Cultivars (%)						
	NPGS	NFC	TOC	Commercial	Veteto and Carlson (2014)	Total available	Unavailable
Category 1 ^z	56	11	21	1	1	90	10
Category 2 ^y	25	12	24	6	2	65	35
Category 3 ^x	20	12	24	0	0	55	45
Category 4 ^w	7	4	10	1	1	22	78

^zCategory 1 apple cultivars were present in at least 10 of the 49 nursery catalogs dated between 1888 and 1907 or identified in at least three time periods in the literature (before 1830, between 1830 and 1869, and between 1870 and 1907).

^yCategory 2 cultivars were identified in the literature in at least two time periods (either before 1830 and between 1830 and 1869, or between 1830 and 1869 and between 1870 and 1907).

^xCategory 3 cultivars were only found in the literature in one time period (before 1830, between 1830 and 1869, or between 1870 and 1907) and were also recommended by the American Pomological Society (APS).

^wCategory 4 cultivars were found only in the literature in one time period (before 1830, between 1830 and 1869, or between 1870 and 1907) but were not included in the APS recommendations. Category 4 cultivars were also those that were listed in the APS recommendations, but not documented in the literature.

EARLY-MID-CEN-APS cultivars were also placed into category 1. Category 2 cultivars were defined as those that were classified as EARLY-MID, MID-CEN, EARLY-MID-APS, or MID-CEN-APS. Category 3 cultivars were those that were listed in a single era, and were also recommended by APS (EARLY-APS, MID-APS, CEN-APS). Category 4 cultivars were those listed for a single era (EARLY, MID, CEN) but were not on the list recommended by APS. Category 4 cultivars were also cultivars that were recommended by APS but not listed in any of the literature that was surveyed (APS).

All data were recorded in Excel 2010 (Microsoft, Redmond, WA) and displayed using Excel 2010 and SigmaPlot 11.0 (Systat Software, San Jose, CA).

Results

Apple cultivar lists were compiled from 66 documents (Supplemental Table 1). The 3687 apple cultivar entries were organized into 891 standardized names. Of these 891 names, 706 did not have any synonyms, 95 had a single synonym, 37 had two synonyms, 18 had three synonyms, 15 had four synonyms, and 20 had between 5 and 16 synonyms (Supplemental Table 2).

The most frequently mentioned cultivars in the literature and catalogs that were inventoried were Ben Davis (60 citations), Early Harvest (57 citations), Yellow Bellflower (55 citations), Golden Russet (51 citations), Red Astrachan (48 citations), Duchess of Oldenburg (47 citations), Winesap (46 citations), Rhode Island Greening (41 citations), Jonathan (39 citations), Wealthy (38 citations), and Yellow Transparent (38 citations).

The numbers of cultivars in each of the classification categories are provided in Table 1. In our dataset, 325 cultivars originated in the EARLY time period, 370 cultivars originated in the MID time period, and 123 cultivars originated in the CEN time period (Table 1). Of these, 99 of the EARLY, 83 of the MID, and 41 of the CEN cultivars were recommended by APS in 1908 (Table 1). Introduction dates were not available for 73 cultivars that were only listed by APS.

A total of 331 unique apple cultivars were listed in 49 nursery catalogs dated from 1888 to 1907. Ninety-three of these apple cultivars were listed in more than 10 of the 49 nursery catalogs. These 93 cultivars originated in the following eras: EARLY (51 cultivars), MID (31 cultivars), and CEN (11 cultivars), and all were recommended by APS (Table 1).

CATEGORY CLASSIFICATION. The 891 apple cultivars were classified into four categories using cultivar longevity and popularity to target cultivars for acquisition and conservation. Category 1 included 150 apple cultivars. Category 2 included 101 cultivars and 51 cultivars were placed into the third category (Table 2). There were 589 cultivars placed into the fourth category.

By definition, category 1 cultivars had many citations, but hundreds of the documented cultivars had only a single citation, and most of these were classified as category 4 cultivars (Fig. 1). The mean duration ($\pm$ SE) for category 1, 2, 3, and 4 cultivars was 201 ± 8 , 206 ± 18 , 96 ± 10 , and 50 ± 3 years, respectively (Fig. 2).

WHERE DID U.S. APPLES COME FROM? Of the cultivars classified as EARLY, 56% originated as seedlings in the United States (Fig. 3). The remaining cultivars that were classified as EARLY were imported as scions or trees into North America

Fig. 1. The number of apple cultivars (separated by category) and their frequency of citations in the literature [71 references (Supplemental Table 1)]. The bar for catalog frequency = 1 extends to 527 cultivars. Category 1 apple cultivars were present in at least 10 of the 49 nursery catalogs dated between 1888 and 1907 or identified in at least three time periods in the literature (before 1830, between 1830 and 1869, and between 1870 and 1907). Category 2 cultivars were identified in the literature in at least two time periods (either before 1830 and between 1830 and 1869, or between 1830 and 1869 and between 1870 and 1907). Category 3 cultivars were only found in the literature in one time period (before 1830, between 1830 and 1869, or between 1870 and 1907) and were also recommended by the American Pomological Society [APS (Ragan, 1909)]. Category 4 cultivars were found in the literature in one time period (before 1830, between 1830 and 1869, or between 1870 and 1907), but were not included in the APS recommendations. Category 4 cultivars were also those that were listed in the APS recommendations, but not documented in the literature.

from Europe and Russia in the 1600s to early 1800s. Our work identified 83 apple cultivars available in 2015 that were imported as scions in the EARLY time period. These apple cultivars were from the United Kingdom (43 cultivars), France (15 cultivars), Russia/Formal Soviet Union (5 cultivars), Germany (5 cultivars), and other European countries (10 cultivars). Five EARLY cultivars originated in Canada (Table 3; Fig. 4A). Eleven of the EARLY cultivars available in 2015 did not have known source countries.

Information compiled from the listings provided by Ragan (1905) for apple cultivars present in the United States between 1804 and 1904 revealed an influx of apple cultivar imports from Russia (Ragan, 1905). The large number of Russian cultivar imports was in part due to an introduction of Russian winter-hardy apples for use in the Great Plains by USDA and the Iowa Agricultural College in 1870 (Gibb, 1884). According to Ragan (1905), 1095 apple cultivars grown in the United States originated from Russia (424 cultivars), United Kingdom (387 cultivars), Canada (70 cultivars), France (68 cultivars), Germany (45 cultivars), Belgium (16 cultivars), and other European countries (85 cultivars) (Fig. 4B).

CURRENT AVAILABILITY OF CULTIVARS. As of 2015, NPGS maintained living trees of 56%, 25%, 20%, and 7% of the apple cultivars that were classified as category 1, 2, 3, and 4, respectively. When the NFC was included in the analyses, availability proportions rose to 67%, 37%, 32%, and 11% for the category 1, 2, 3, and 4 cultivars, respectively. When organizations such as the Temperate Orchard Conservancy and the information within Veteto and Carlson (2014), as well as commercial nurseries were considered, the proportion of

category 1, 2, 3, and 4 cultivars that were available in 2015 increased to 90%, 65%, 55%, and 22%, respectively (Table 3). In all, 135 of the 150 category 1 cultivars, 66 of the 101 category 2 cultivars, 28 of the 51 category 3 cultivars, and 130 of the 589 category 4 cultivars were found to be available in 2015 in the U.S. and U.K. genebanks and within the queried commercial and private collections in the United States (Table 3). There are more category 4 cultivars that are unavailable, compared with the number of category 1, 2, and 3 cultivars

Fig. 2. Average duration of apple cultivar availability (with SE) calculated by subtracting the introduction date from the most recent recorded date for each cultivar. Category 1 apple cultivars were present in at least 10 of the 49 nursery catalogs dated between 1888 and 1907 or identified in at least three time periods in the literature (before 1830, between 1830 and 1869, and between 1870 and 1907). Category 2 cultivars were identified in the literature in at least two time periods (either before 1830 and between 1830 and 1869, or between 1830 and 1869 and between 1870 and 1907). Category 3 cultivars were only found in the literature in one time period (before 1830, between 1830 and 1869, or between 1870 and 1907) and were also recommended by the American Pomological Society [APS (Ragan, 1909)]. Category 4 cultivars were found only in the literature in one time period (before 1830, between 1830 and 1869, or between 1870 and 1907) but were not included in the APS recommendations. Category 4 cultivars were also those that were listed in the APS recommendations, but not documented in the literature.

Fig. 3. World map depicting the original source of apple cultivars that were grown in the United States before 1830. Country contributions of 2% or greater are shown. Fifty-six percent of the apple cultivars grown in the United States before 1830 originated as seedlings in the United States. The arrow is thickest for the United Kingdom, which was the source of the largest percentage of imported apple cultivars.

that are unavailable. Those cultivars were only minimally documented in the historic literature and might not have been actively propagated as clones or distributed through nurseries (Fig. 5). Alternatively, some of these cultivar names might be synonymous with more widespread, prominent cultivars.

Of the 156 EARLY cultivars (both originating in the United States and elsewhere), 14 of the category 1 cultivars, 17 of the category 2 cultivars, 3 of the category 3 cultivars, and 122 of the category 4 cultivars were not available in NPGS, NFC, or from the commercial and private sources in the United States that were queried (Supplemental Table 2). The unavailable cultivars might still be available through other genebanks, public, or private collections.

Discussion

"Not if I had a hundred tongues, a hundred mouths, An iron voice, could I describe all the forms And reckon up all the names of these wild apples." (Thoreau, 1913)

In the United States, hundreds of thousands of seedling apple trees were planted between 1600 and 1905 for juice (to be made into hard cider) and fruit consumption (Dolan, 2009). A small fraction of these apple trees were named and/or recorded in various regional contests focused on finding new apple cultivars of interest. Still fewer of these trees were propagated, sold, and recognized as new desirable cultivars originating in North America (Diamond, 2010). We sought to identify apple cultivars with potential historical significance by documenting the presence of the names of apple cultivars over time and their frequency of mention in nursery catalogs. This strategy has its limitations because it is based on available documentation; however, it provides insights into the apple cultivars that were once widely available. Although we recognize that our work is not exhaustive, we believe our work is sufficiently thorough to identify primary historic American cultivars. It is likely that some historically significant apple cultivars have been omitted from our analyses or misclassified due to the information that was available. Future efforts that make use of additional historical sources will likely reveal additional cultivars of interest.

Patterns in the persistence of named cultivars do not directly measure the degree of genetic diversity that existed because many names may represent synonyms (Gross et al., 2012; van Treuren et al., 2010). A study by the Rural Advancement Foundation International (RAFI) in 1982 (cited by Fowler and Mooney, 1990; Heald and Chapman, 2016) determined that, of the 7098 apple cultivars found between 1804 and 1904 in the United States (Ragan, 1905), 6121 (86%) were not available in NPGS in 1983. The RAFI study did not take into account synonymous cultivar names or the agronomical/historical importance of the cultivars that were named, and was likely an overestimation of the cultivars

Table 3. Apple cultivars that were introduced to the United States before 1830 in the form of scions or trees that are currently available (based on name). Category ranks 1–4 were determined based on persistence in the literature and frequency of presence in nursery catalogs between 1888 and 1907. Availability was determined by presence in the online inventories of the U.S. Department of Agriculture, Agricultural Research Service National Plant Germplasm System (NPGS), National Fruit Collection (NFC, Brodgate, UK), and Temperate Orchard Conservancy (TOC, Molalla, OR).

Cultivar	Source	Origin yr	Category rank ^z	Category classification	Current availability
Acklam Russet	England	1768	4	EARLY	NFC
Alexander	Russia	1700	1	EARLY-MID-CEN-APS	NPGS
Antonovka	Russia	1826	3	EARLY-APS	NPGS
Autumn Pearmain	England	1590	2	EARLY-MID	NFC
Baumann's Reinette	Belgium	1811	2	EARLY-MID	NPGS
Baxter	Canada	1800	1	EARLY-MID-CEN-APS	NPGS
Beauty of Kent	England	1820	1	EARLY-MID-CEN-APS	NFC
Belle de Boskoop	The Netherlands	1782	1	EARLY-MID-CEN	NPGS
Blenheim Orange	United Kingdom	1740	2	EARLY-MID-APS	NPGS
Boiken	Germany	1828	1	EARLY-MID-CEN-APS	NPGS
Borsdorf	Germany	1500	1	EARLY-MID-CEN	NFC
Brown Pippin	United Kingdom	1782	4	EARLY	NPGS
Burr Apple	England	1782	4	EARLY	NFC
Calville Blanc d'Hiver	France	1598	2	EARLY-MID	NPGS
Calville Rouge d'Ete	France	1810	4	EARLY	TOC
Canada Reinette	France	1771	1	EARLY-MID-CEN-APS	NFC
Cat's Head	England	1600	4	EARLY	NFC
Charlamoff	Former Soviet Union	1700	1	EARLY-MID-CEN-APS	NPGS
EARLYes Quince	United Kingdom	1782	1	EARLY-MID-CEN-APS	NPGS
Cornish Aromatic	United Kingdom	1782	2	EARLY-MID	NPGS
Courpendu Bardin	France	1667	4	EARLY	NFC
Court of Wyck	England	1790	2	EARLY-MID	NFC
Court pendu plat	United Kingdom	1613	4	EARLY	NPGS
Cox's Orange Pippin	United Kingdom	1825	1	EARLY-MID-CEN	NPGS
Devonshire	England	1754	4	EARLY	NFC
Dutch Codlin	The Netherlands	1782	2	EARLY-MID	NFC
Eight Square	Ireland	1782	4	EARLY	NFC
Fameuse	Canada	1730	1	EARLY-MID-CEN-APS	NPGS
Fenouillet Rouge	France	1667	4	EARLY	NFC
Flanders Pippin	France	1782	4	EARLY	NPGS
Foxwhelp	United Kingdom	1664	4	EARLY	NPGS
French Crab	France	1754	4	EARLY	NPGS
French Pippin	Ireland	1755	1	EARLY-MID-CEN-APS	NPGS
Gilliflower	United Kingdom	1629	1	EARLY-MID-CEN	NPGS
Gloria Mundi	Germany	1769	1	EARLY-MID-CEN	NPGS
Golden Harvey	United Kingdom	1600	2	EARLY-MID	NPGS
Golden Pippin	Ireland	1735	1	EARLY-MID-CEN-APS	NPGS
Golden Reinette	Europe	1600	4	EARLY	NFC
Golden Russet	United Kingdom	1714	1	EARLY-MID-CEN-APS	NPGS
Gravenstein	Denmark	1669	1	EARLY-MID-CEN-APS	NPGS
Hawthornden	Scotland	1780	2	EARLY-MID	NFC
Herefordshire Pearmain	United Kingdom	1200	2	EARLY-MID	NPGS
Herefordshire Red Streak	England	1798	4	EARLY	TOC
Irish Peach	Ireland	1820	1	EARLY-MID-CEN-APS	NPGS
Jungferen	Germany	1736	4	EARLY	NPGS
Kentish Fill Basket	England	1782	4	EARLY	NFC
Keswick's Codlin	England	1793	1	EARLY-MID-CEN-APS	NFC
King of the Pippins	England	1800	4	MID	NFC
Lady	France	1628	1	EARLY-MID-CEN-APS	NPGS
Lady Finger	France	1893	1	EARLY-MID-CEN	TOC
Lemon Pippin	United Kingdom	1700	2	EARLY-MID	NPGS
London Pippin	United Kingdom	1580	1	EARLY-MID-CEN	NPGS
Margaret	United Kingdom	1665	1	EARLY-MID-CEN-APS	NPGS
Margil	United Kingdom	1750	2	EARLY-MID	NPGS

Continued next page

Table 3. Continued.

Cultivar	Source	Origin yr	Category rank ^z	Category classification	Current availability
McAfee's Nonsuch	Europe	1613	1	EARLY-MID-CEN-APS	NPGS
Melonen	Germany	1700	3	EARLY-APS	NFC
Minchal Crab	England	1777	4	EARLY	NFC
Nonpareil	France	1500	2	EARLY-MID	NPGS
Nonsuch	England	1782	4	EARLY	NFC
Norfolk Beefing	United Kingdom	1782	4	EARLY	NPGS
Norfolk Pippin	England	1782	4	EARLY	NPGS
Northern Greening	England	1810	4	EARLY	NPGS
Ontario	Canada	1820	1	EARLY-MID-CEN-APS	NPGS
Peach	England	1818	1	EARLY-MID-CEN-APS	TOC
Pearmain	France	1200	1	EARLY-MID-CEN	NFC
Pine Apple Pippin	England	1782	4	EARLY	NFC
Pomme Grise	Canada	1769	2	EARLY-MID-APS	NPGS
Red apple	Canada	1736	4	EARLY	NPGS
Red Astrachan	Russia	1816	1	EARLY-MID-CEN-APS	NPGS
Red Calville	France	1500	2	EARLY-MID	NFC
Red Quarrendon	France	1678	2	EARLY-MID	NFC
Red Streak	United Kingdom	1600	1	EARLY-MID-CEN	NPGS
Reinette Doree	France	1740	2	EARLY-MID-APS	NFC
Reinette Grise	France	1600	4	EARLY	TOC
Ribston	United Kingdom	1707	1	EARLY-MID-CEN-APS	NPGS
Royal Wildings	England	1784	4	EARLY	TOC
Scarlet Pearmain	England	1782	2	EARLY-MID	NFC
White Astrachan	Former Soviet Union	1748	1	EARLY-MID-CEN-APS	NPGS
White Stone Pippin	United Kingdom	1782	4	EARLY	NPGS
White Winter Pearmain	United Kingdom	1200	1	EARLY-MID-CEN-APS	NPGS
Winter Majetin	United Kingdom	1820	1	EARLY-MID-CEN	NPGS
Woodcock	England	1754	4	EARLY	NFC
Yellow Ingestrie	England	1800	2	EARLY-MID	NFC

^zCategory 1 apple cultivars were present in at least 10 of the 49 nursery catalogs dated between 1888 and 1907 or identified in at least three time periods in the literature (before 1830, between 1830 and 1869, and between 1870 and 1907). Category 2 cultivars were identified in the literature in at least two time periods (either before 1830 and between 1830 and 1869, or between 1830 and 1869 and between 1870 and 1907). Category 3 cultivars were only found in the literature in one time period (before 1830, between 1830 and 1869, or between 1870 and 1907) and were also recommended by the American Pomological Society (APS). Category 4 cultivars were found only in the literature in one time period (before 1830, between 1830 and 1869, or between 1870 and 1907) but were not included in the APS recommendations. Category 4 cultivars were also those that were listed in the APS recommendations, but not documented in the literature.

Fig. 4. Apple cultivars present in the United States that originated in other countries. (A) Countries from which at least 3% of the cultivars were imported before 1830. (B) Countries from which at least 3% of the cultivars were imported between 1805 and 1905 (from Ragan, 1905). Year listings for 5A and 5B overlap because data were derived from different sources.

important for preservation. Although we could not definitively remove all synonyms from our inventoried cultivars, we did identify and standardize cultivar names to removed etymological duplicates.

Availability of historic materials in the United States has been dependent on access to cultivars in the national collections of other countries (such as England), apple breeder collections,

public and private collections, and from commercial nurseries. The data herein provide an update to the previously published report (Fowler and Mooney, 1990), and demonstrate that 90% of the apple cultivars that were ranked as category 1 in the current study are available (Table 2), although NPGS fruit collection clonal germplasm repositories have only been in place since the 1980s [the first farm manager for the PGRU was hired in 1983 and the first curator for the apple collection was hired in 1984 (Postman et al., 2006)].

Since every apple seedling is unique, it is both impractical and impossible to conserve every apple genotype within genebank collections. Instead, a critical subset of the important variation is conserved. This subset is most likely a combination of landrace, historical, recent cultivars, key breeding lines and parents, mutants with desirable traits, and representative subsets of wild species. These genebank materials serve as genetic resources for cultivar comparisons, breeding, and research applications (Holland et al., 2006; Volk et al., 2015).

The importance of maintaining valuable cultivars in genebanks is underscored by the fact that commercially available apple cultivars have changed over time (Bonany et al., 2014;

Fig. 5. Availability in 2015 of 891 historic apple cultivars. The sources were queried in the following order: U.S. Department of Agriculture, Agricultural Research Service National Plant Germplasm System, National Fruit Collection (Brodgale, UK), Temperate Orchard Conservancy (Molalla, OR), Greenmantle Nursery (Garberville, CA), Urban Homestead (Bristol, VA), Kuffel Creek Apple Tree Nursery (Riverside, CA), Albemarle CiderWorks (North Garden, VA), Salt Spring Apple Co. (Salt Spring Island, BC, Canada), and Veteto and Carlson (2014). If cultivars or synonyms were not available from any of these sources, they were considered unavailable. Category 1 apple cultivars were present in at least 10 of the 49 nursery catalogs dated between 1888 and 1907 or identified in at least three time periods in the literature (before 1830, between 1830 and 1869, and between 1870 and 1907). Category 2 cultivars were identified in the literature in at least two time periods (either before 1830 and between 1830 and 1869, or between 1830 and 1869 and between 1870 and 1907). Category 3 cultivars were only found in the literature in one time period (before 1830, between 1830 and 1869, or between 1870 and 1907) and were also recommended by the American Pomological Society [APS (Ragan, 1909)]. Category 4 cultivars were found only in the literature in one time period (before 1830, between 1830 and 1869, or between 1870 and 1907) but were not included in the APS recommendations. Category 4 cultivars were also those that were listed in the APS recommendations, but not documented in the literature.

Dolan, 2009; Yue and Tong, 2011). Previous work demonstrated that there were no significant changes in the genetic diversity of *M. ×domestica* across the last 8 centuries; however, there is a lower level of diversity represented by the cultivars that are currently produced commercially (Gross et al., 2014; Noiton and Alspach, 1996). Dolan (2009) counted the number of apple cultivars available in Stark Brothers Nursery (Louisiana, MO) catalogs between 1918 and 1935. Dolan (2009) found that 95 cultivars were available in 1918, 33 cultivars were available in 1928, and 19 cultivars were available in 1935. Dolan (2009) also identified a significant shift in the most popular cultivars between 1910 and 1942. The most popular apple cultivars in 1910 were Baldwin, Ben Davis, Jonathan, Northern Spy, Rhode Island Greening, Roxbury Russett, Winesap, King of Tompkin's County, Newtown Pippin, and York Imperial (Dolan, 2009). By 1942, the most popular apple cultivars were Red Delicious, Jonathan, McIntosh, Rome Beauty, York Imperial, Stayman Winesap, Northern Spy, Rhode Island Greening, Newtown Pippin, and Grimes Golden (Dolan, 2009). The 1910 list of cultivars included all cultivars identified in this work. It is notable that in our references, 'Red Delicious', also known as 'Hawkeye', was only cited twice. By 1942, 'Red Delicious' had grown to be the most popular apple

cultivar and it is still grown on the most acreage in the United States today (Volk et al., 2015).

Apple trees that are genetically identical to the original named cultivars have been maintained for centuries because apples are clonally propagated (Juniper and Mabberley, 2006). For example, Herefordshire Pearmain and White Winter Pearmain are apple cultivars that were first documented as early as 1200 CE and are still available (Smith, 1971). Because apple trees can live for more than 100 years, original historic cultivars remain in fields, but many of those trees are dying (Routson et al., 2009). In 2014, Veteto and Carlson wrote a survey of 633 distinct ethnotaxa of heirloom apples (synonyms not removed) identified in southern Appalachia. Their report documented the existence of 328 orchards in North Carolina in 1976, which had declined to 117 orchards in 2006. In this region, consumer demand for modern cultivars is resulting in the phasing out of many historic cultivars (Veteto and Carlson, 2014). We compared our list of unavailable materials to the inventory presented by Veteto and Carlson (2014) and found 10 historic cultivars that might still be available in Appalachian orchards (Fall Orange, Greening, Hall's Red, Haskell's Sweet, Hogshead, Honey, Spencer's Pippin, Summer Limbertwig, Delaware Red Winter, and Red Winter).

There is an interest in determining the identity of historic fruit trees in private collections and on public lands. Historic cultivars in the NPGS collection provide a standard reference for DNA fingerprinting efforts (Bassil et al., 2008; Routson et al., 2009). This reference set of information would be strengthened by the inclusion of samples of important historic cultivars that are not currently available in NPGS. The existence of a DNA fingerprinting database aids in cultivar identification and also serves as collection management tool in the identification of duplicates or possibly mislabeled collection materials (Gross et al., 2012).

As consumers, in the form of hobbyists and horticultural plant collectors as well as niche market producers, embrace the concept of consuming fruit cultivars that are genetically identical to those that were consumed decades or centuries ago, historic apple cultivars become valued and appreciated (Burford, 2013; Hatch, 1998). It is likely that a network of national and international apple collections, as well as nonprofit organizations and commercial nurseries, will ensure that historical apple cultivars are available for centuries to come.

"I fear that he who walks over these fields a century hence will not know the pleasure of knocking off wild apples. Ah, poor man, there are many pleasures which he will not know!" (Thoreau, 1913)

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Supplemental Table 1. References from which apple cultivar names were retrieved.

Classification ^z	Catalog/book name	Publication date	Cultivars in source (no.)	Nursery location	Source author and yr
APS	APS recommendations	1909	318		Ragan, 1909
CEN	Pleasant Valley Nurseries	1903	11	New Jersey	NAL online catalog ^y
CEN	Wedge Nursery	1900	13	Minnesota	NAL online catalog
CEN	Comal Springs Nursery	1902	13	Texas	NAL online catalog
CEN	Willow Lake	1900	16	Georgia	NAL online catalog
CEN	Sussex Nursery	1904	16	Delaware	NAL online catalog
CEN	Charles Pennock	1894	19	Colorado	NAL online catalog
CEN	Hale's Fruits	1902	19	Connecticut	NAL online catalog
CEN	Baker Brothers	1905	19	Texas	NAL online catalog
CEN	Crete Nurseries	1904	21	Nebraska	NAL online catalog
CEN	Mid-Continental Nursery	1889	23	Nebraska	NAL online catalog
CEN	James T Bogue	1893	26	California	NAL online catalog
CEN	Watkins	1901	26	California	NAL online catalog
CEN	Stoner's Nurseries	1895	30	Kansas	NAL online catalog
CEN	Sebastopol Nurseries	1904	30	California	NAL online catalog
CEN	Multnomah Nurseries	1894	32	Oregon	NAL online catalog
CEN	Munson Nursery	1905	32	Texas	NAL online catalog
CEN	New Haven Nurseries	1905	32	Missouri	NAL online catalog
CEN	Brock Nurseries	1903	33	Nebraska	NAL online catalog
CEN	Glen Rock Nurseries	1904	34	Pennsylvania	NAL online catalog
CEN	Kemp Brothers	1899	35	Pennsylvania	NAL online catalog
CEN	L.T. Sanders' Orchard	1892	37	Louisiana	NAL online catalog
	Home Nursery				
CEN	Milwaukee-Canby Nursery	1893	38	Wisconsin	NAL online catalog
CEN	Midway Nurseries	1891	39	Nebraska	NAL online catalog
CEN	Pioneer Nurseries	1905	40	Utah	NAL online catalog
CEN	Analy Nurseries	1906	40	California	NAL online catalog
CEN	West Michigan Nurseries	1903	41	Michigan	NAL online catalog
CEN	Rogers Nursery	1893	42	New Jersey	NAL online catalog
CEN	Smith's Nursery and Fruit Farm	1893	42	Tennessee	NAL online catalog
CEN	Linn County Nursery	1903	45	Iowa	NAL online catalog
CEN	Weber and Sons	1903	47	Missouri	NAL online catalog
CEN	Cayuga Nurseries	1905	47	New York	NAL online catalog
CEN	Green's Nursery	1900	48	New York	NAL online catalog
CEN	Rancho Chico Nurseries	1888	52	California	NAL online catalog
CEN	Pacific Nursery Company	1903	53	Oregon	NAL online catalog
CEN	Willis Nurseries	1902	54	Kansas	NAL online catalog
CEN	Geneva Nurseries	1904	54	Nebraska	NAL online catalog
CEN	Storrs and Harrison	1903	56	Ohio	NAL online catalog
CEN	Stark Brothers	1907	57	Missouri	NAL online catalog
CEN	Reid's Nurseries	1895	58	Ohio	NAL online catalog
CEN	Sears Henry and Company	1903	70	New York	NAL online catalog
CEN	Ca Nursery company	1902	72	California	NAL online catalog
CEN	T. W. Wood and Sons	1896	74	Virginia	NAL online catalog
CEN	Elmwood Nurseries	1898	74	Virginia	NAL online catalog
CEN	Storrs & Harrison	1890	78	Ohio	NAL online catalog
CEN	Munson Hill Nurseries	1902	80	Virginia	NAL online catalog
CEN	Rio Bonito	1894	94	California	NAL online catalog
CEN	Monroe Nursery	1899	102	Michigan	NAL online catalog
CEN	Hart Pioneer Nurseries	1895	104	Kansas	NAL online catalog
CEN	Franklin Davis	1905	129	Maryland	NAL online catalog
EARLY	St George Tucker	1784	14		Chappell, 2000
EARLY	William Byrd II	1736	16		Chappell, 2000
EARLY	Compleat Cyderman	1754	16		Ellis, 1754
EARLY	Thomas Sorsby	1763	18		Chappell, 2000
EARLY	Strachan and Maury	1798	21		Chappell, 2000
EARLY	William Smith	1755	21		Chappell, 2000

Continued next page

Supplemental Table 1. Continued.

Classification ^z	Catalog/book name	Publication date	Cultivars in source (no.)	Nursery location	Source author and yr
EARLY	Samuel Bailey	1804	23		Chappell, 2000
EARLY	Monticello	Various	53		Hatch, 1998
EARLY	William Booth Catalog	1810	90		Chappell, 2000
EARLY	William Pinkerton	1782	102		Online catalog, NAL
MID	Grown by Jacob Smith	1844	11		Chappell, 2000
MID	The Most Valuable Varieties of Fruit	1848	68		Kenrick, 1848
MID	New American Orchardist	1835	116		Kenrick, 1835
MID	Vineland Nursery	1858	122		Chappell, 2000
	The Book of Apples	Various	14		Morgan and Richards, 1993
	American Pomology Apples	Various	417		Warder, 1867

^zAPS = American Pomological Society; EARLY = before 1830; MID = 1830–69; CEN = 1870–1907.

^yNAL = National Agricultural Library, Beltsville, MD.

Supplemental Table 2. List of historic apple cultivars, priority category, classification, availability, introduction (Init.), and most recent observation date, original country, number of citations in source literature, and the number of synonyms.

Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
Acklam Russet	4	EARLY	NFC		England	1768	2015	3	1
Akin	2	MID-CEN-APS	NPGS	PI 588958	United States	1831	2015	4	0
Alban Crann	4	EARLY	Not available			1810	1810	1	0
Alexander	1	EARLY-MID-CEN-APS	NPGS	PI 589107	Russia	1700	2015	24	0
Allen's Choice	3	CEN-APS	Not available		United States	1903	1909	2	1
Allen's Pippin	4	MID	Not available		United States	1858	1858	1	0
American Beauty	2	EARLY-MID-APS	NFC		United States	1800	2015	1	0
American Black	4	MID	NFC		United States	1867	2015	1	0
American Pippin	1	EARLY-MID-CEN	TOC		United States ¹	1810	2015	4	0
American Summer Pearmain	1	EARLY-MID-CEN-APS	NPGS	PI 589214	United States	1714	2015	21	1
Angle Sweet	4	MID	Not available		United States	1867	1867	1	0
Anisim	3	CEN-APS	NPGS	PI 590025	Former Soviet Union	1900	2015	3	0
Annette	4	CEN	Not available		United States	1903	1903	1	0
Antonovka	3	EARLY-APS	NPGS	PI 588784	Russia	1826	2015	1	0
Apple of Commerce	4	APS (CEN)	NPGS	PI 589149	United States	1909	2015	2	1
Arctic	4	APS (CEN)	Not available		United States	1909	1909	1	0
Arkansas	1	MID-CEN-APS	NPGS	PI 588952	United States	1833	2015	23	2
Arkansas Black	1	CEN-APS	NPGS	PI 589117	United States	1870	2015	26	0
Arnold's Beauty	3	CEN-APS	Not available		United States	1890	1909	2	0
Aromatic Carolina	4	MID	Not available		United States	1858	1858	1	0
Ashmore	4	MID	Not available		United States	1854	1884	1	0
August Tart	4	MID	Not available		United States	1854	1867	1	0
Aunt's Apple	4	MID	Not available		United States	1831	1872	1	0
Autumn Pearmain	2	EARLY-MID	NFC	PI 27014	England	1590	2015	2	0
Autumn Sweet Bough	2	EARLY-MID-APS	Not available		United States	1810	1909	3	0
Autumn Sweet Swaar	2	MID-CEN-APS	Not available		United States	1848	1909	5	5
Babbitt	4	MID	Not available		United States	1838	1905	5	1
Baccalinus	4	MID	Not available		United States	1867	1872	1	0
Bailey Sweet	1	MID-CEN-APS	TOC		United States	1867	2015	17	0
Bailey's Golden	4	MID	Not available		United States	1867	1867	1	0
Baker's Nonsuch	4	EARLY	Not available		United States	1755	1755	1	0
Baker's Pearmain	4	EARLY	Not available			1755	1755	1	0
Baldwin	1	EARLY-MID-CEN-APS	NPGS	PI 589884	United States	1740	2015	35	0
Baltzley	4	CEN	TOC		United States	1878	2015	1	0
Bannister's Pippin	4	EARLY	Not available			1782	1782	1	0
Barker's Liner	4	CEN	TOC		United States	1871	2015	1	0
Barry	4	CEN	NPGS	PI 589428	United States	1905	2015	1	0
Baumann's Reinette	2	EARLY-MID	NPGS	PI 589566	Belgium	1811	2015	1	0
Baxter	1	EARLY-MID-CEN-APS	NPGS	PI 589848	Canada	1800	2015	3	0
Bayard	4	CEN	Not available		United States	1902	1907	2	0

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Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
Beau	4	MID	Not available		United States	1835	1896	1	0
Beauty of Kent	1	EARLY-MID-CEN-APS	NFC	PI 136245		1820	2015	3	1
Beauty of the West	4	MID	Not available		United States	1831	1905	2	0
Beeler's Russet	4	MID	Not available		United States	1867	1867	1	0
Belden Sweet	4	MID	Not available		United States	1854	1883	1	0
Bell	1	EARLY	Not available			1798	1798	1	0
Belle de Boskoop	1	EARLY-MID-CEN	NPGS	PI 300258	The Netherlands	1782	2015	4	0
Belmont	1	EARLY-MID-CEN-APS	NFC		United States	1817	2015	6	0
Ben Davis	1	EARLY-MID-CEN-APS	NPGS	PI 588953	United States	1800	2015	60	8
Ben Hur	4	CEN	Not available		United States	1907	1907	1	0
Benoni	1	MID-CEN-APS	NPGS	PI 589120	United States	1832	2015	13	0
Bentley Sweet	2	MID-CEN-APS	TOC		United States	1867	2015	5	2
Berry Red	1	EARLY-MID-CEN	Not available		United States	1812	1905	3	1
Bethel	3	CEN-APS	TOC		United States	1899	2015	3	0
Bethlemite	4	MID	Not available		United States	1858	1905	1	0
Better than Good	4	MID	Not available		United States	1854	1884	1	0
Beverly's Red	4	MID	Not available		United States	1835	1835	1	0
Bietigheimer	1	CEN-APS	NPGS	PI 589043	Germany	1888	2015	22	1
Bismarck	1	CEN-APS	NFC		Australia	1870	2015	13	0
Black Annette	3	EARLY-APS	Not available		Ireland	1810	1934	2	1
Black Ben Davis	4	CEN	NPGS	PI 589178	United States	1880	2015	2	0
Black Pippin	4	EARLY	Not available		England	1782	1872	1	0
Black Redstricke	4	EARLY	Not available			1810	1810	1	0
Black Twig	2	MID-CEN	TOC		United States	1833	2015	2	0
Black Warrior	4	MID	Not available		United States	1858	1858	1	0
Blaxton's Yellow Sweeting	4	EARLY	Not available			1654	1654	1	0
Bledsoe's Favorite	2	MID-CEN-APS	Not available		United States	1867	1909	3	0
Blenheim Orange	2	EARLY-MID-APS	NPGS	PI 589593	United Kingdom	1740	2015	2	1
Blinkbonny	4	MID	Not available		Canada	1858	1858	1	0
Blockley	4	MID	Not available		United States	1867	1872	1	0
Blondin	4	MID	Not available		United States	1867	1867	1	0
Blue Pearmain	1	EARLY-MID-CEN-APS	NPGS	PI 590180	United States	1800	2015	5	0
Bluff Sweet	4	MID	Not available		United States	1867	1867	1	0
Boalsburg	4	MID	Not available		United States	1854	1884	1	0
Bogdanoff	4	APS (CEN)	Not available		Russia	1909	1909	1	0
Bohanon	4	MID	Not available		United States	1854	1895	1	0
Boiken	1	EARLY-MID-CEN-APS	NPGS	PI 589134	Germany	1828	2015	3	0
Bonum	1	EARLY-MID-CEN-APS	NPGS	PI 588946	United States	1784	2015	32	12
Borsdorf	1	EARLY-MID-CEN	NFC		Germany	1500	2015	1	0
Bostick Queen	4	CEN	Not available		United States	1891	1893	1	0
Bottle Greening	2	MID-CEN	TOC		United States	1850	2015	4	0

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Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
Bourassa	4	MID	Not available		Europe	1831	1872	1	0
Bowling Sweet	4	MID	Not available		United States	1859	1867	1	0
Boxford	4	MID	Not available		United States	1835	1884	1	0
Bracken	2	EARLY-MID	Not available		United States	1812	1867	1	0
Brandywine	4	MID	TOC		United States	1848	2015	2	1
Bray's White Apple	4	EARLY	Not available			1755	1763	2	0
Brenneman	4	MID	Not available		United States	1867	1882	1	0
Brewington Pippin	4	APS (MID)	Not available		United States	1870	1909	1	0
Brilliant of Patten	4	APS (CEN)	Not available		United States	1909	1909	1	0
Briser	4	MID	Not available			1858	1858	1	0
Brittle Sweet	4	MID	Not available		United States	1867	1895	1	0
Broadwell Sweet	2	MID-CEN-APS	Not available		United States	1854	1909	3	1
Brook's Pippin	4	MID	Not available		United States	1852	1867	1	0
Brown Pippin	4	EARLY	NPGS	PI 589662	United Kingdom	1782	2015	1	0
Brown's winter	4	EARLY	Not available		United States	1810	1895	1	0
Bruce's summer	4	MID	Not available			1858	1858	1	0
Bryson's Seedling	4	CEN	TOC		United States	1905	2015	1	0
Buckingham	1	EARLY-MID-CEN-APS	TOC		United States	1736	2015	20	8
Buff	2	MID-CEN	TOC		United States	1853	2015	3	0
Bull's head	4	EARLY	Not available			1810	1810	1	0
Burr Apple	4	EARLY	NFC		England	1782	2015	1	0
Bush	4	MID	Not available		United States	1867	1867	1	0
Butter	4	MID	TOC		United States	1867	2015	1	0
C E White	4	CEN	Not available		United States	1904	1904	1	0
Caleb	4	MID	Not available		United States	1867	1867	1	0
Calville Blanc d'Ete	4	EARLY	Not available		France	1810	1831	1	0
Calville Blanc d'Hiver	2	EARLY-MID	NPGS	PI 589596	France	1598	2015	5	4
Calville Rouge d'Ete	4	EARLY	TOC		France	1810	2015	1	0
Canack Sweet	4	MID	TOC		United States	1867	2015	1	0
Campfield	2	EARLY-MID	TOC		United States	1817	2015	1	0
Canada Baldwin	3	CEN-APS	Not available		Canada	1903	1909	2	0
Canada Reinette	1	EARLY-MID-CEN-APS	NFC		France	1771	2015	4	0
Cane Creek	4	MID	Not available		United States	1858	1858	1	0
Cannon Pearmain	1	EARLY-MID-CEN-APS	TOC		United States	1804	2015	5	0
Capital	4	MID	Not available		United States	1867	1867	1	0
Carlough	4	APS (CEN)	Not available		United States	1909	1909	1	0
Carnak's Sweet	4	APS (CEN)	Not available		United States	1909	1909	1	0
Carolina Baldwin	4	MID	Not available		United States	1867	1896	1	0
Carolina Greening	4	MID	Not available		United States	1854	1905	1	0
Carolina Red June	1	EARLY-MID-CEN-APS	TOC		United States	1827	2015	32	2
Carpentich	4	EARLY	Not available			1736	1736	1	0
Carpenter's Choice	4	CEN	Not available		United States	1903	1903	1	0

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Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
Cary's Summer	4	MID	Not available		United States	1867	1872	1	0
Catline	2	EARLY-MID	Not available		United States	1810	1835	2	1
Cat's Head	4	EARLY	NFC			1782	2015	2	1
Catsbury	4	EARLY	Not available			1810	1810	1	0
Cawood's Timely	4	EARLY	Not available		United States	1782	1782	1	0
Celestia	3	MID-APS	TOC		United States	1867	2015	2	0
Challenge	4	MID	Not available		United States	1854	1872	1	0
Champlain	2	MID-CEN-APS	NPGS	PI 588949	United States	1867	2015	5	2
Chancelor	4	MID	Not available		United States	1848	1883	1	0
Chandler	4	MID	TOC		United States	1835	2015	1	0
Chapman	4	MID	Not available		United States	1848	1848	1	0
Charlamoff	1	EARLY-MID-CEN-APS	NPGS	PI 588978	Former Soviet Union	1700	2015	3	1
Cheesborough	4	MID	Not available		United States	1867	1867	1	0
Chenango Strawberry	1	MID-CEN-APS	NPGS	PI 589239	United States	1850	2015	11	2
Chester Pearmain	4	EARLY	Not available		United States	1782	1782	1	0
Christmas	4	APS (CEN)	NPGS	PI 125263	United States	1909	2015	1	0
Chronicle	4	MID	Not available		United States	1867	1883	1	0
Clarke's Pearmain	1	EARLY-MID	NPGS	PI 392306	United States	1755	2015	12	4
Clark's Orange	4	CEN	TOC		United States	1877	2015	1	0
Clayton	2	MID-CEN-APS	Not available		United States	1867	1909	7	0
Clopton's Hangfast	4	EARLY	Not available		United States	1804	1804	1	0
Cluster Pearmain	4	MID	Not available		United States	1867	1872	1	0
Cluster Russet	4	EARLY	Not available		United States	1782	1782	1	0
Clyde Beauty	2	MID-CEN-APS	Not available		United States	1851	1909	3	0
Clyman pippin	4	CEN	Not available		United States	1904	1904	1	0
Coffelt	4	CEN	Not available		United States	1887	1907	2	0
Coftard	4	EARLY	Not available		United States	1782	1782	1	0
Cogswell Pearmain	2	EARLY-MID-APS	Not available		United States	1750	1905	2	1
Coles Quince	1	EARLY-MID-CEN-APS	NPGS	PI 129820	United Kingdom	1782	2015	5	2
Colorado Orange	4	APS (CEN)	Not available		United States	1909	1909	1	0
Colvert	2	MID-CEN	TOC		United States	1867	2015	3	0
Common Redstripe	4	EARLY	Not available		United States	1810	1810	1	0
Conant's Red	4	MID	Not available		United States	1867	1872	1	0
Congress	4	APS (CEN)	Not available		United States	1909	1909	1	0
Cook's seedling	4	MID	TOC		United States	1868	2015	3	0
Cooper's Early	3	CEN-APS	NPGS	PI 588855	United States	1796	2015	5	2
Cooper's Market	1	EARLY-MID-CEN-APS	TOC		United States	1804	2015	5	1
Cornell's Fancy	4	APS (CEN)	Not available		United States	1909	1909	1	0
Cornfield	4	MID	Not available		United States	1850	1872	1	0
Cornish Aromatic	2	EARLY-MID	NPGS	PI 590121	United Kingdom	1782	2015	3	2
Corse's Favorite	4	MID	Not available		Canada	1833	1872	1	0
Corse's Indian Prince	4	MID	Not available		United States	1835	1835	1	0

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Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
Cos	4	MID	Not available		United States	1831	1884	1	0
Courpendu Bardin	4	EARLY	NFC		France	1667	2015	1	0
Court of Wyck	2	EARLY-MID	NFC		England	1790	2015	1	0
Court pendu plat	4	EARLY	NPGS	PI 123960	United Kingdom	1613	2015	1	0
Cowley Crabs	4	EARLY	Not available			1754	1754	1	0
Cox's Orange Pippin	1	EARLY-MID-CEN	NPGS	PI 588853	United Kingdom	1825	2015	1	0
Cracking	4	MID	Not available		United States	1867	1909	2	0
Cram	3	MID-APS	Not available		United States	1835	1835	1	0
Cranberry	2	MID-CEN-APS	NPGS	PI 589180	United States	1867	2015	3	1
Cranberry Russet	4	MID	Not available		United States	1867	1867	1	0
Crawford Keeper	4	MID	Not available		United States	1867	1867	1	0
Crimson Beauty	4	MID	NPGS	PI 589024	Canada	1880	2015	1	0
Cropsey's Favorite	4	MID	Not available		United States	1867	1867	1	0
Cross	4	APS (MID)	Not available		United States	1846	1909	1	0
Crow Egg	4	MID	NPGS	PI 589196	United States	1835	2015	1	0
Crownest	4	MID	Not available		United States	1867	1967	1	0
Crumpton	4	CEN	Not available		United States	1896	1898	2	0
Cullasaga	2	MID-CEN-APS	TOC		United States	1830	2015	4	1
Cullawhee	4	MID	Not available		United States	1858	1884	1	0
Culp	4	MID	Not available		United States	1867	1883	1	0
Cumberland Spice	4	MID	NPGS	PI 590220	United States	1835	2015	2	0
Curtis	4	MID	Not available		United States	1835	1862	1	0
Curtis Greening	4	MID	Not available		United States	1867	1867	1	0
D W M Blush	4	CEN	Not available		United States	1904	1904	1	0
Dally Apple	4	EARLY	Not available		United States	1782	1782	1	0
Dalton	4	MID	Not available		United States	1867	1867	1	0
Dan Pearmain	4	MID	Not available		United States	1867	1867	1	0
Dana	4	MID	Not available		United States	1867	1872	1	0
Daniel	4	MID	Not available		United States	1867	1895	1	0
Danver's Sweet	1	EARLY-MID-CEN-APS	Not available		United States	1763	1909	6	3
Dartmouth Sweeting	4	MID	Not available		United States	1835	1835	1	0
Dawson's Cluster	4	MID	Not available		United States	1867	1867	1	0
Defiance	4	MID	Not available		United States	1858	1895	1	0
Delaware Red Winter	1	CEN-APS	Veteto and Carlson		United States	1878	2015	25	4
Delicious	3	CEN-APS	NPGS	PI 589841	United States	1879	2015	2	0
Delight	4	MID	Not available		United States	1854	1872	1	0
Democrat	4	MID	NPGS	PI 589111	Australia	1867	2015	1	0
Derby Seeknofurther	4	APS (CEN)	Not available		United States	1909	1909	1	0
Detroit Red	2	EARLY-MID	TOC		United States	1769	2015	3	1
Devonshire	4	EARLY	NFC		England	1754	2015	1	0
Dickinson	4	CEN	Not available		United States	1905	1905	1	0
Dillingham	4	MID	Not available		United States	1854	1882	1	0

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Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
Disharoon	4	MID	TOC		United States	1858	2015	1	0
Doctor	4	EARLY	Not available		United States	1784	1810	2	0
Doctor Barnard's Baking	4	EARLY	Not available			1782	1782	1	0
Doctor Dewitt	3	EARLY-APS	Not available		United States	1817	1909	1	0
Doctor Fulcher	4	MID	Not available		United States	1867	1867	1	0
Dominie	1	MID-CEN-APS	NPGS	PI 173979	France	1835	2015	12	3
Donneghan	4	APS (CEN)	Not available		United States	1909	1909	1	0
Downing's Paragon	4	MID	Not available		United States	1867	1895	1	0
Doyle	4	CEN	Not available		United States	1889	1905	1	0
Dr. Walker	4	CEN	Not available		United States	1893	1893	1	0
Dr. Watson	4	MID	Not available		United States	1867	1867	1	0
Drap d'Or	4	MID	NPGS	PI 131823	France	1835	2015	3	0
Duchess of Hamilton	4	EARLY	Not available			1810	1872	1	0
Duchess of Oldenburg	1	MID-CEN-APS	NPGS	PI 589562	Russia	1835	2015	47	4
Duckett	4	MID	Not available		United States	1858	1884	1	0
Dudley	4	APS (CEN)	NPGS	PI 589910	United States	1891	1909	1	0
Duffield Pippin	4	MID	Not available		United States	1867	1872	1	0
Duling	4	MID	Not available		England	1831	1907	1	0
Dunbar	4	MID	Not available		United States	1859	1902	1	0
Dutch Codlin	2	EARLY-MID	NFC		The Netherlands	1782	2015	4	3
Dutch Pippin	4	EARLY	Not available			1755	1863	1	1
Dyer	3	MID-APS	NFC		United States	1835	2015	4	1
Early Bow	4	EARLY	Not available			1784	1810	2	1
Early Celton	4	APS (CEN)	Not available		United States	1909	1909	1	0
Early Codling	4	EARLY	Not available			1810	1810	1	0
Early Cooper	4	APS (CEN)	Not available		United States	1909	1909	1	0
Early Cotton	4	CEN	Not available		United States	1893	1893	1	0
Early EARLYton	4	CEN	Not available		United States	1902	1907	3	0
Early Harvest	1	EARLY-MID-CEN-APS	NPGS	PI 589015	United States	1769	2015	57	3
Early Market	4	APS (CEN)	Not available		United States	1909	1909	1	0
Early Melon	4	CEN	TOC		United States	1907	2015	1	0
Early Pennock	2	MID-CEN-APS	Not available		United States	1850	1909	5	0
Early Scarlet	4	APS (CEN)	Not available		United States	1909	1909	1	0
Early Strawberry	1	MID-CEN-APS	NFC		United States	1835	2015	18	0
Edward's Early	1	EARLY-MID-CEN	Not available		United States	1810	1902	1	0
Egyptian Russet	4	MID	Not available		United States	1867	1872	1	0
Eight Square	4	EARLY	NFC		Ireland	1782	2015	1	0
El Dorado	4	MID	NFC		United States	1858	2015	1	0
Elarkee	4	MID	Not available		United States	1857	1858	1	0
Ellis's Hughes	4	EARLY	Not available			1763	1763	1	0
Ellis's Red Streak	4	EARLY	Not available			1798	1798	1	0
Ene's Winter Sweet	4	MID	Not available		United States	1867	1867	1	0

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Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
English Codling	2	EARLY-MID-APS	Not available		England	1688	1810	6	3
Ensee	4	APS (CEN)	TOC		United States	1909	2015	1	0
Esopus Spitzenburg	1	EARLY-MID-CEN-APS	NPGS	PI 588785	United States	1735	2015	26	2
Evelyn	4	APS (CEN)	NPGS	PI 589456	United States	1909	2015	1	0
Evening Party	3	MID-APS	Not available		United States	1855	1905	2	0
Everlasting	4	EARLY	Not available		United States	1790	1872	1	0
Ewalt	2	MID-CEN	Not available		United States	1850	1905	2	0
Eyer's Greening	4	EARLY	Not available		England	1782	1872	1	0
Fall Butter	4	MID	Not available		United States	1867	1867	1	0
Fall Geneting	2	MID-CEN-APS	TOC		United States	1846	2015	3	2
Fall Harvest	4	EARLY	Not available			1736	1736	1	0
Fall Orange	1	EARLY-MID-CEN-APS	Veteto and Carlson		United States	1770	2015	4	0
Fall Pippin	1	EARLY-MID-CEN-APS	NPGS	PI 588954	United States	1806	2015	30	4
Fall Wine	1	EARLY-MID-CEN-APS	TOC			1810	2015	9	3
Fallwater	1	MID-CEN-APS	NPGS	PI 589294	United States	1842	2015	18	2
Famagusta	4	EARLY	Not available		England	1810	1810	1	0
Fameuse	1	EARLY-MID-CEN-APS	NPGS	PI 588793	Canada	1730	2015	37	2
Family	3	MID-APS	Not available		United States	1858	1905	3	0
Fancher	4	MID	Not available		United States	1867	1867	1	0
Fanny	3	CEN-APS	NPGS	PI 589123	Australia	1880	2015	6	0
Farley Red	4	MID	Not available		United States	1867	1867	1	0
Farrar	4	APS (CEN)	Not available		United States	1909	1909	1	0
Father Abraham	2	EARLY-MID	TOC		United States	1755	2015	5	2
Faust	4	MID	TOC		United States	1867	2015	1	0
Fenouillet Rouge	4	EARLY	NFC		France	1667	2015	1	0
Ferdinand	4	MID	Not available		United States	1848	1867	1	0
Filbert	4	APS (CEN)	Not available		United States	1909	1909	1	0
Fine Red Calville	4	EARLY	Not available			1782	1782	1	0
Fink	4	MID	Not available		United States	1867	1884	1	0
Finley	4	MID	Not available		United States	1867	1872	1	0
Flanders Pippin	4	EARLY	NPGS	PI 127358	France	1782	1920	1	0
Flat Crab	4	EARLY	Not available			1804	1804	1	0
Flat Sweet	4	MID	Not available		United States	1858	1858	1	0
Flora Bell	4	CEN	Not available		United States	1891	1904	2	0
Flushing Spitzenburg	1	EARLY-MID-CEN	Not available		United States	1810	1905	4	1
Forbidden Fruit	4	EARLY	Not available			1782	1782	1	0
Fort Miami	4	MID	Not available		United States	1846	1872	1	0
Foundling	3	MID-APS	Not available		United States	1854	1909	2	0
Foxwhelp	4	EARLY	NPGS	PI 589318	United Kingdom	1664	2015	2	0
Franklin Golden	4	MID	Not available		United States	1867	1867	1	0
French Crab	4	EARLY	NPGS	PI 588908		1754	2015	2	0
French Pippin	1	EARLY-MID-CEN-APS	NPGS	PI 590141	Ireland	1755	2015	14	4

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Supplemental Table 2. Continued.

Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
French Rennet	4	EARLY	TOC		United States	1736	2015	2	1
Frost	4	EARLY	Not available			1810	1810	1	0
Fulton	2	MID-CEN-APS	Not available		United States	1867	1909	3	0
Gabriel	4	MID	Not available		United States	1854	1882	1	0
Gano	1	CEN-APS	TOC		United States	1880	2015	26	0
Garden Royal	3	MID-APS	TOC		United States	1867	2015	2	1
Gardner Sweeting	4	MID	Not available		United States	1835	1883	1	0
Garfield	4	APS (CEN)	Not available		United States	1909	1909	1	0
Gargrove	4	APS (CEN)	Not available		United States	1909	1909	1	0
Garretson's Early	4	MID	Not available		United States	1858	1867	2	0
Genesee Chief	4	MID	Not available		United States	1867	1872	1	0
Georgia Red June	4	MID	Not available		United States	1858	1858	1	0
Gideon	3	CEN-APS	NPGS	PI 589078	United States	1882	2015	6	0
Gillefe's Cyder Apple	4	EARLY	Not available			1755	1755	1	0
Gillflower	1	EARLY-MID-CEN	NPGS	PI 590023	United Kingdom	1629	2015	1	0
Gill's Beauty	4	CEN	Not available		United States	1895	1895	1	0
Gilpin	1	MID-CEN-APS	NPGS	PI 588850	United States	1810	2015	21	6
Gipsy Girl	1	EARLY-MID-CEN	Not available		Germany	1653	1915	1	0
Glendale	4	MID	Not available		United States	1867	1867	1	0
Gloria Mundi	1	EARLY-MID-CEN	NPGS	PI 589040	Germany	1769	2015	13	4
Gloucester White	1	EARLY-MID-CEN	Not available		United States	1817	1902	5	0
Golay	4	MID	Not available		United States	1867	1872	1	0
Golden Ball	4	MID	Not available		United States	1867	1888	1	0
Golden Harvey	2	EARLY-MID	NPGS	PI 590128	United States	1600	2015	1	0
Golden Pippin	1	EARLY-MID-CEN-APS	NPGS	PI 206024	United Kingdom	1735	2015	1	0
Golden Reinette	4	EARLY	NFC		Ireland	1600	2015	24	5
Golden Russet	1	EARLY-MID-CEN-APS	NPGS	PI 589892	Europe	1714	2015	2	1
Golden Sweet	1	MID-CEN-APS	TOC		United Kingdom	1848	2015	51	10
Golden Truce Russet	4	EARLY	Not available		United States	1782	2015	18	1
Golden Wilding	4	EARLY	Not available		United States	1769	1782	1	0
Golding	4	APS (CEN)	Not available		United States	1909	1804	2	0
Gordon's Seedling	4	MID	Not available		United States	1858	1909	1	0
Graham apple	4	CEN	TOC		United States	1858	1858	1	0
Graham Baldwin	4	CEN	Not available		England	1884	2015	1	0
Graham White	4	CEN	Not available		United States	1906	1906	1	0
Granniwinkle	4	MID	Not available		United States	1895	1902	1	0
Gravenstein	1	EARLY-MID-CEN-APS	TOC		United States	1854	2015	1	0
Great Rambour	4	EARLY	NPGS	PI 249923	Denmark	1669	2015	35	1
Green Apple	4	EARLY	Not available			1782	1782	1	0
Green Blundril	4	EARLY	Not available			1736	1883	1	0
Green Crank	4	MID	Not available		United States	1782	1782	1	0
Green Glass	4	APS (CEN)	Not available		United States	1854	1884	1	0
					United States	1909	1909	1	0

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Supplemental Table 2. Continued.

Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
Green Olive	4	EARLY	Not available		United States	1810	1810	1	0
Green Russet	4	MID	TOC		United States	1867	2015	1	0
Green Sweet	2	MID-CEN	NPGS	PI 590086	United States	1835	2015	7	1
Greening	4	EARLY	Veteto and Carlson		United States	1798	2015	1	0
Greenville	2	MID-CEN	TOC		United States	1858	2015	3	0
Greenwood Russet	4	EARLY	Not available		United States	1782	1884	1	0
Grey Leadington	4	EARLY	Not available		Scotland	1782	1884	1	0
Grimes Golden	1	EARLY-MID-CEN-APS	NPGS	PI 588791	United States	1804	2015	37	3
Hagloe	2	MID-CEN	Not available		United States	1850	1903	2	0
Hague	4	MID	Not available		United States	1867	1867	1	0
Hall's Red	2	MID-CEN-APS	Veteto and Carlson		United States	1867	2015	4	0
Hampton's Russet	4	MID	Not available		United States	1867	1872	1	0
Hannah	4	MID	Not available		United States	1867	1867	1	0
Harnish	4	MID	Not available		United States	1867	1867	1	0
Harris	4	MID	TOC		United States	1867	2015	1	0
Harrison	2	EARLY-MID	NPGS		United States	1755	2015	3	1
Harry Kaump	4	APS (CEN)	Not available		United States	1909	1909	1	0
Hartford Wine	4	MID	Not available			1858	1858	1	0
Harvest Redstreak	4	MID	Not available		United States	1867	1867	1	0
Harvey	2	EARLY-MID-APS	NFC		United States	1714	2015	4	2
Harwinton	4	MID	Not available			1858	1858	1	0
Haskell's Sweet	4	MID	Veteto and Carlson		United States	1867	2015	1	0
Hatcher's Seedling	4	CEN	Not available		United States	1870	1895	1	0
Hawley	1	EARLY-MID-CEN-APS	NFC		United States	1750	2015	4	0
Hawthornden	2	EARLY-MID	NFC		Scotland	1780	2015	1	0
Hay Boys	4	MID	Not available		United States	1867	1867	1	0
Hay's Wise	4	CEN	Not available		United States	1895	1895	1	0
Heidemeyer	4	MID	Not available		Germany	1850	1902	1	0
Henwood	4	MID	Not available		United States	1867	1872	1	0
Herdon's Cheese	4	EARLY	Not available			1798	1798	1	0
Herefordshire Pearmain	2	EARLY-MID	NPGS	PI 590133	United Kingdom	1200	2015	3	1
Herefordshire Red Streak	4	EARLY	TOC			1798	2015	2	1
Herefordshire Underleaf	4	EARLY	Not available			1754	1754	1	0
Herman	4	MID	NPGS	PI 274066	United States	1867	2015	1	0
Hershal Cox	4	CEN	Not available		United States	1900	1902	1	0
Hewes Crab	1	EARLY-MID-CEN	TOC		United States	1741	2015	10	5
Hibernal	4	APS (MID)	NPGS	PI 589911	United States	1870	2015	5	0
Higby Sweet	4	MID	Not available		United States	1867	1872	1	0
High top Sweet	1	EARLY-MID-CEN-APS	TOC		United States	1600	2015	18	3
Hiley's Eureka	4	CEN	Not available		United States	1879	1900	1	0
Hockett's Sweet	4	APS (CEN)	Not available		United States	1872	1909	1	0
Hogshead	4	EARLY	Veteto and Carlson			1754	2015	1	0

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Supplemental Table 2. Continued.

Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
Holland Pippin	1	EARLY-MID-CEN	NFC		United States	1755	2015	6	0
Holly	4	MID	TOC		United States	1858	2015	1	0
Holmes	3	EARLY-APS	Not available		United States	1822	1909	1	0
Holston Sweet	4	MID	Not available		United States	1867	1867	1	0
Honey	4	MID	Veteto and Carlson		United States	1867	2015	1	0
Hoover	2	MID-CEN-APS	NPGS	PI 265302	United States	1850	2015	8	0
Hopewell	4	APS (CEN)	Not available		United States	1909	1909	1	0
Horn	4	APS (MID)	Not available		United States	1852	1909	1	0
Horse	1	EARLY-MID-CEN-APS	TOC		United States	1763	2015	30	3
Hubbardston Nonsuch	1	MID-CEN-APS	NPGS	PI 589202	United States	1830	2015	24	5
Hull Blossom	4	MID	Not available		United States	1867	1872	1	0
Hunge	3	MID-APS	TOC		United States	1867	2015	2	0
Hunt Russet	2	EARLY-MID-APS	TOC		United States	1867	2015	3	2
Huntsman	1	MID-CEN-APS	TOC		United States	1850	2015	10	1
Hyde's King	3	CEN-APS	TOC		United States	1890	2015	4	2
Hyslop	4	CEN	TOC		United States	1894	2015	1	0
Indiana Beauty	4	MID	Not available		United States	1867	1867	1	0
Indiana Favorite	3	MID-APS	Not available		United States	1867	1909	2	0
Ingram	2	MID-CEN-APS	NPGS	PI 589072	United States	1855	2015	6	0
Iowa Beauty	4	APS (CEN)	TOC		United States	1909	2015	1	0
Iowa Blush	3	CEN-APS	TOC		United States	1891	2015	6	0
Iowa Russet	4	CEN	Not available		United States	1891	1891	1	0
Irish Crab	4	EARLY	Not available			1754	1754	1	0
Irish Peach	1	EARLY-MID-CEN-APS	NPGS	PI 104727	Ireland	1820	2015	2	0
Iron Wilding	4	EARLY	Not available			1769	1769	1	0
Isham's Sweet	3	CEN-APS	Not available		United States	1894	1909	4	1
Ivanhoe	4	CEN	NPGS	PI 589637	United States	1896	2015	3	0
Jacob Sweet	3	CEN-APS	TOC		United States	1893	2015	4	1
Jarminite	4	MID	Not available		United States	1867	1884	1	0
Jeffers	2	MID-CEN-APS	NPGS	PI 589185	United States	1830	2015	8	2
Jennings' Sweet	4	MID	Not available		United States	1835	1835	1	0
Jersey	4	EARLY	Not available			1754	1754	1	0
Jersey Black	2	EARLY-MID-APS	NFC		United States	1817	2015	2	0
Jersey Sweet	1	MID-CEN-APS	TOC		United States	1848	2015	11	0
JerUSAlem	4	EARLY	Not available		France	1600	1810	1	0
Jewett Red	4	APS (MID)	NPGS	PI 644185	United States	1842	2015	1	0
Jonathan	1	EARLY-MID-CEN-APS	NPGS	PI 590185	United States	1826	2015	39	0
Jones' Seedling	4	MID	Not available		United States	1863	1938	1	0
Jordan	4	CEN	Not available		United States	1903	1946	1	0
Julienne	4	APS (MID)	Not available		United States	1853	1909	2	0
Junaluskee	3	MID-APS	TOC		United States	1850	2015	3	1

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Supplemental Table 2. Continued.

Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
June Apple	1	EARLY-MID-CEN	Not available		United States	1798	1898	6	1
Juneating	2	EARLY-MID-APS	Not available		England	1600	1920	9	5
Jungferen	4	EARLY	NPGS	PI 132759	Germany	1736	2015	1	0
Juntin' apple	4	EARLY	Not available			1736	1736	1	0
Kabapffel	4	EARLY	Not available			1736	1736	1	0
Kaighn's Spitzenburg	2	EARLY-MID	NPGS	PI 589100	United States	1817	2015	2	1
Kane	4	MID	TOC		United States	1848	2015	2	0
Keiser	4	MID	Not available		United States	1831	1872	1	0
Kennard's Choice	4	CEN	Not available		United States	1870	1905	1	0
Kerrick	4	MID	Not available		United States	1835	1872	1	0
Kentish Codlin	4	EARLY	Not available			1782	1782	2	1
Kentish Fill Basket	4	EARLY	NFC		England	1782	2015	1	0
Kentish Reinette	4	EARLY	Not available			1782	1863	1	0
Kentucky King	4	MID	Not available		United States	1867	1867	1	0
Kernodle	4	APS (CEN)	Not available		United States	1885	1909	1	0
Kerton Pippin	4	EARLY	Not available			1782	1782	1	0
Keswick's Codlin	1	EARLY-MID-CEN-APS	NFC		England	1793	2015	12	2
Killam Hill	4	MID	Not available		United States	1835	1835	1	0
King	1	EARLY-MID-CEN-APS	NFC		United States	1804	2015	26	2
King David	3	CEN-APS	NPGS	PI 589156	United States	1893	2015	2	0
King of the Pippins	4	MID	NFC		England	1800	2015	1	0
King Wagner	4	CEN	Not available		United States	1893	1893	1	0
Kinney's Winter	4	MID	Not available		United States	1858	1869	1	0
Kippeling's Pippin	4	EARLY	Not available			1782	1782	1	0
Kirkbridge White	3	MID-APS	Not available		United States	1867	1909	2	1
Kitchen Rennet	4	EARLY	Not available		United States	1782	1883	1	0
Klaproth	4	MID	Not available		United States	1867	1895	1	0
Kluz	4	CEN	Not available		United States	1895	1895	1	0
Knickerbocker	4	MID	Not available		United States	1867	1872	1	0
Knock Russet	4	MID	Not available		United States	1867	1867	1	0
Knowles' Early	4	MID	Not available		United States	1853	1872	1	0
Krauser	2	MID-CEN	Not available		United States	1867	1903	2	0
Lacker	4	MID	Not available		United States	1847	1905	1	0
Lader-goller	4	EARLY	Not available			1736	1736	1	0
Lady	1	EARLY-MID-CEN-APS	NPGS	PI 589053	France	1628	2015	29	5
Lady Finger	1	EARLY-MID-CEN	TOC		France	1893	2015	2	1
Lancashire Defiance	4	EARLY	Not available			1782	1782	1	0
Lancaster Sweet	4	MID	Not available		United States	1867	1867	1	0
Lane	4	MID	NFC		England	1840	2015	1	0
Langsburg	3	MID-APS	Not available		United States	1867	1909	4	1
Lankford's Seedling	2	MID-CEN-APS	Not available		United States	1840	1909	5	2
Large Green Calville	4	EARLY	Not available			1810	1810	1	0

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Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
Large White Sweeting	4	EARLY	Not available			1790	1810	1	0
Late Bellflower	4	CEN	Not available		United States	1906	1906	1	0
Late Strawberry	1	MID-CEN-APS	NPGS	PI 589066	United States	1848	2015	14	1
Lauslugburg	4	CEN	Not available		United States	1895	1895	1	0
Leech's Kingsessing	4	MID	Not available		United States	1848	1848	1	0
Lehigh Greening	4	APS (MID)	TOC		United States	1845	2015	1	0
Lemon Pippin	2	EARLY-MID	NPGS	PI 157731	United Kingdom	1700	2015	2	0
Lewis	4	MID	Not available		United States	1867	1884	2	0
Lewis's Crab	4	EARLY	Not available			1798	1798	1	0
Liberty	4	MID	NPGS	PI 588943	United States	1867	2015	1	0
Lightfoot's Pearmain	4	EARLY	Not available			1804	1804	1	0
Lilly of Kent	4	APS (CEN)	Not available		United States	1909	1909	1	0
Limbertwig	1	EARLY-MID-CEN-APS	TOC		United States	1750	2015	13	1
LinEARL Ynshire Beaufin	4	EARLY	Not available			1782	1782	1	0
LinEARL Ynshire Rennet	4	EARLY	Not available			1782	1782	1	0
Litchfield Pounder	4	MID	Not available			1858	1858	1	0
Livland Raspberry	3	CEN-APS	NFC		Russia	1883	2015	3	2
Loan's Pearmain	4	EARLY	Not available		England	1665	1782	1	0
Lodge	4	MID	Not available		United States	1848	1848	1	0
London Pippin	1	EARLY-MID-CEN	NPGS	PI 590132	United Kingdom	1580	2015	3	2
London Sweet	4	MID	Not available		United States	1854	1884	1	0
Londonderry	4	MID	Not available		United States	1835	1835	1	0
Lone's Pearmain	4	EARLY	Not available			1755	1755	1	0
Long Crab	4	EARLY	Not available			1804	1804	1	0
Long Island Pippin	4	MID	Not available		United States	1867	1895	1	0
Long Island Russet	4	MID	Not available		United States	1869	1905	1	0
Long Island Seek-no-further	4	MID	Not available		United States	1854	1905	1	0
Long Meg	4	EARLY	Not available			1782	1782	1	0
Long Pippin	4	EARLY	Not available			1810	1872	1	0
Long Stem	4	EARLY	TOC		United States	1784	2015	2	0
Longfield	1	CEN-APS	NPGS	PI 590024	United States	1870	2015	13	0
Long-stem apple	4	EARLY	TOC		Russia	1736	2015	1	0
Lord Grosvenor	4	APS (CEN)	NFC		United States	1872	2015	1	0
Lowrey	4	MID	TOC		United States	1850	2015	2	1
Loy	3	CEN-APS	Not available		United States	1870	1909	4	0
Lubsk Reinette	4	APS (CEN)	Not available		United States	1909	1909	1	0
Ludwell's Seedling	4	EARLY	Not available		United States	1755	1909	1	0
Lyscom	2	EARLY-MID	TOC		United States	1817	2015	2	0
Mackay Sweeting	4	MID	Not available		United States	1835	1872	1	0
Magnate	4	APS (MID)	Not available		United States	1866	1909	1	0
Magog Red Streak	3	CEN-APS	TOC		United States	1905	2015	2	1
Maiden Blush	1	EARLY-MID-CEN-APS	NPGS	PI 589105	United States	1810	2015	37	1

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Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
Malenka	4	CEN	Not available		United States	1900	1900	1	0
Malinda	2	MID-CEN-APS	NPGS	PI 613817	United States	1860	2015	3	1
Mann	1	MID-CEN-APS	NPGS	PI 589200	United States	1850	2015	19	0
Mansfield Russet	4	MID	Not available		United States	1867	1884	1	0
Margaret	1	EARLY-MID-CEN-APS	NPGS	PI 123730	United Kingdom	1665	2015	9	6
Margil	2	EARLY-MID	NPGS	PI 264558	United Kingdom	1750	2015	2	1
Marigold	4	MID	Not available		England	1835	1888	1	0
Marquise	4	MID	Not available		United States	1835	1835	1	0
Marshall Red	2	MID-CEN-APS	Not available		United States	1835	1888	4	2
Marston's Red	4	MID	Not available		United States	1854	1895	1	0
Martha	4	CEN	NPGS	PI 589061	United States	1879	2015	4	0
Mason's Stranger	4	MID	Not available		United States	1838	1905	1	0
Mattamuskeet	4	MID	TOC		United States	1858	2015	1	0
Maverack Sweet	4	MID	Not available		United States	1858	1867	2	1
Maxson's Early	4	CEN	Not available		United States	1903	1903	1	0
May Apple	1	EARLY-MID-CEN	TOC		United States	1755	2015	7	2
McAdow's June	2	EARLY-MID	Not available		Russia	1807	1905	1	0
McAfee's Nonsuch	1	EARLY-MID-CEN-APS	NPGS	PI 588849	Europe	1613	2015	14	6
McCuller's Winter	4	APS (CEN)	TOC		United States	1909	2015	1	0
McDaniel	4	MID	Not available		United States	1867	1867	1	0
McDowell's Sweet	4	MID	Not available		United States	1858	1858	1	0
McIntosh Red	1	CEN-APS	NPGS	PI 588817	Canada	1890	2015	15	1
McKinley Greening	2	MID-CEN	Not available		United States	1867	1872	2	1
McLellan	3	EARLY-APS	NFC		United States	1780	2015	1	0
McMahan	3	CEN-APS	TOC		United States	1903	2015	6	1
Meach	4	MID	Not available		United States	1867	1872	1	0
Melon	3	MID-APS	NPGS	PI 342430	United States	1845	2015	3	0
Melonen	3	EARLY-APS	NFC		Germany	1700	2015	1	0
Mexico	4	MID	Not available		United States	1867	1872	1	0
Michael Henry Pippin	1	EARLY-MID-CEN	TOC		United States	1817	2015	4	1
Michigan Golden	4	MID	Not available		United States	1867	1867	1	0
Middle	4	MID	Not available		United States	1867	1867	1	0
Mifflin King	4	MID	Not available		United States	1854	1872	1	0
Milam	1	EARLY-MID-CEN-APS	Commercial		United States	1800	2015	12	0
Milding	4	CEN	Not available		United States	1903	1903	1	0
Miller's Hartford	4	EARLY	Not available		United States	1810	1810	1	0
Milwaukee	4	APS (CEN)	NPGS	PI 589216	United States	1899	2015	1	0
Minchal Crab	4	EARLY	NFC		England	1777	2015	1	0
Minister	2	MID-CEN-APS	Not available		United States	1838	1909	4	0
Minkler	2	MID-CEN-APS	TOC		United States	1842	2015	6	0
Missing Link	4	CEN	Not available		United States	1902	1902	1	0

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Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
Missoula	4	APS (CEN)	Not available		United States	1909	1909	1	0
Missouri Pippin	1	MID-CEN-APS	TOC		United States	1839	2015	21	0
Monk's Favorite	4	MID	Not available		United States	1854	1892	1	0
Moon	4	CEN	Not available		United States	1873	1892	1	0
Moore Sweet	2	EARLY-MID-APS	Not available		United States	1829	1909	2	1
Morgan White	4	MID	Not available		United States	1867	1872	1	0
Morris red apple	4	MID	Not available		United States	1858	1904	1	0
Morse	4	CEN	Not available		United States	1905	1905	1	0
Morton	4	MID	Not available		United States	1859	1872	1	0
Mote's Sweet	4	MID	Not available		United States	1867	1872	1	0
Mother	2	MID-CEN-APS	NPGS	PI 589077	United States	1844	2015	5	0
Mother Jean	4	EARLY	Not available		United States	1810	1810	1	0
Mountain Sweet	4	MID	Not available		United States	1867	1905	1	0
Mrs. Bryan	3	CEN-APS	TOC		United States	1870	2015	2	0
Munson Sweet	1	MID-CEN-APS	TOC		United States	1849	2015	11	1
Murphy	4	MID	Not available		United States	1835	1884	1	0
Muster	4	MID	TOC		United States	1867	2015	1	0
Mylum's Pearmain	4	EARLY	Not available		United States	1798	1798	1	0
Nansemond Beauty	3	CEN-APS	Not available		United States	1875	1909	4	1
Nantahalee	4	MID	Not available		United States	1855	1884	1	0
Nelson Sweet	4	APS (CEN)	Not available		United States	1909	1909	1	0
Nequassa	4	MID	Not available		United States	1860	1884	1	0
Nero	3	CEN-APS	Not available		United States	1884	1909	2	0
Neversink	4	MID	Not available		United States	1854	1895	1	0
New Biggan	4	EARLY	Not available		United States	1782	1782	1	0
New England American	4	EARLY	Not available		United States	1782	1782	1	0
New Town American	4	EARLY	Not available		United States	1782	1782	1	0
New York American	4	EARLY	Not available		United States	1782	1782	1	0
Newark King	4	MID	Not available		United States	1835	1867	2	0
Newell	4	APS (CEN)	Not available		United States	1909	1909	1	0
Newtown Pippin	1	EARLY-MID-CEN-APS	NPGS	PI 588773	United States	1755	2015	43	10
New-York Yellow apples	4	EARLY	Not available		United States	1763	1763	1	0
Nickajack	1	MID-CEN-APS	TOC		United States	1858	2015	13	3
Nonpareil	2	EARLY-MID	NPGS	PI 280027	France	1500	2015	9	3
Nonsuch	4	EARLY	NFC		England	1782	2015	2	0
Norfolk Beefing	4	EARLY	NPGS	PI 157733	United Kingdom	1782	2015	1	0
Norfolk Paradise	4	EARLY	Not available		England	1782	1782	1	0
Norfolk Pippin	4	EARLY	NPGS	PI 280022	England	1782	2015	1	0
NorId Nelson	4	CEN	Not available		United States	1900	1900	1	0
Northern Greening	4	EARLY	NPGS	PI 135030	England	1810	2015	1	0
Northern Spy	1	EARLY-MID-CEN-APS	NPGS	PI 588872	United States	1800	2015	31	0
Northern Sweet	2	EARLY-MID	Tower Hill		United States	1800	2015	1	0

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Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
Northfield Beauty	4	APS (MID)	TOC		United States	1869	2015	1	0
Northwestern Greening	1	CEN-APS	NPGS	PI 589896	United States	1872	2015	16	0
Nottingham Brown	4	APS (MID)	Not available		United States	1853	1909	1	0
Noxonite	4	CEN	Not available		United States	1907	1907	1	0
Oconee	4	APS (MID)	Not available		United States	1858	1909	1	0
Ohio Nonpareil	1	EARLY-MID-CEN-APS	NPGS	PI 589852	United States	1815	2015	12	1
Ohio Pippin	2	MID-CEN-APS	TOC		United States	1867	2015	9	4
Okabena	4	APS (CEN)	TOC		United States	1909	2015	1	0
Old Town Creek Crab	4	EARLY	Not available		United States	1784	1784	1	0
Ontario	1	EARLY-MID-CEN-APS	NPGS	PI 237702	Canada	1820	2015	4	0
Opalescent	4	CEN	NPGS	PI 589051	United States	1899	2015	3	0
Orange	4	EARLY	TOC		United States	1810	2015	1	0
Orange Sweeting or Russet	4	MID	TOC		United States	1831	2015	2	0
Ortley	1	EARLY-MID-CEN-APS	NPGS	PI 589301	United States	1769	2015	7	1
Osceola	4	MID	Not available		United States	1854	1882	1	0
Oxford Oakpeg	4	EARLY	Not available		United States	1782	1782	1	0
Pamunkey	4	EARLY	Not available		United States	1763	1763	1	0
Paradise Summer Sweet	4	MID	Not available		United States	1867	1867	1	0
Paragon	3	CEN-APS	NPGS	PI 589039	United States	1902	2015	2	0
Partridge Apple	4	EARLY	Not available		United States	1782	1782	1	0
Patten Fameuse	4	APS (CEN)	Not available		United States	1909	1909	1	0
Patten's Greening	3	CEN-APS	Not available		United States	1900	1909	4	1
Pauls Janett	4	CEN	Not available		United States	1892	1892	1	0
Payne's Keeper	3	CEN-APS	Not available		United States	1905	1909	3	2
Peach	1	EARLY-MID-CEN-APS	TOC		England	1818	2015	2	0
Peach Pound Sweet	4	MID	Not available		United States	1848	1905	2	0
Pearmain	1	EARLY-MID-CEN	NFC		France	1200	2015	2	0
Peck's Pleasant	1	MID-CEN-APS	NPGS	PI 589240	United States	1832	2015	11	2
Peerless	3	CEN-APS	NFC		England	1900	2015	2	0
Pennock	1	EARLY-MID-CEN	Not available		United States	1810	1905	6	4
Pennsylvania Sweeting	4	MID	Not available		United States	1867	1867	1	0
Pennsylvania Winesap	4	MID	Not available		United States	1867	1872	1	0
Perfection	4	APS (CEN)	Not available		United States	1909	1909	1	0
Perkins	4	CEN	Not available		United States	1895	1898	2	0
Peter the great	4	MID	NPGS	PI 383513	Russia	1855	2015	2	1
Pewaukee	1	CEN-APS	NPGS	PI 590177	United States	1870	2015	20	0
Phillips' Sweet	4	MID	Not available		United States	1867	1884	1	0
Pickard's Reserve	4	MID	Not available		United States	1863	1905	1	0
Picket	4	CEN	TOC		United States	1893	2015	1	0
Pickman	4	MID	Not available		United States	1833	1895	1	0
Pie Pie	4	EARLY	Not available		United States	1782	1782	1	0
Pile's Russet	4	EARLY	Not available		England	1768	1895	1	0

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Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
Pilot	2	MID-CEN	TOC		United States	1830	2015	3	0
Pine Apple Pippin	4	EARLY	NFC		England	1782	2015	1	0
Plumb's Cider	3	CEN-APS	Not available		United States	1894	1909	6	1
Polly Bright	4	MID	Not available		United States	1854	1867	1	0
Pomme Grise	2	EARLY-MID-APS	NPGS	PI 589242	Canada	1769	2015	5	1
Pomme Royale	4	MID	NFC		United States	1835	2015	1	0
Porter	1	MID-CEN-APS	NPGS	PI 589212	United States	1835	2015	13	0
Pottinger	4	MID	Not available		United States	1867	1872	1	0
Pound Royale	4	MID	TOC		France	1853	2015	1	0
Pownal Spitzenberg	4	MID	Not available		United States	1831	1872	1	0
Premium of 1858	4	MID	Not available		United States	1867	1867	1	0
Press Ewing	4	MID	Not available		United States	1867	1872	1	0
Price's Sweet	4	MID	Not available		United States	1858	1891	1	0
Priestly	2	EARLY-MID	TOC		United States	1810	2015	3	1
Primate	1	EARLY-MID-CEN-APS	NPGS	PI 589229	United States	1804	2015	6	1
Princess Louise	4	APS (CEN)	Not available		United States	1909	1909	1	0
Progress	4	MID	Not available		United States	1854	1895	1	0
Pryor's Red	1	EARLY-MID-CEN-APS	Not available		United States	1775	1934	8	4
Pumpkin Sweet	1	MID-CEN-APS	NPGS	PI 589257	United States	1834	2015	17	4
Putnam Sweet	4	MID	Not available		United States	1867	1872	1	0
Quatre-Guise	4	EARLY	Not available			1782	1782	1	0
Queen's Thin Skin	4	EARLY	Not available			1810	1810	1	0
Rabun	4	MID	TOC		United States	1858	2015	1	0
Ragan' Red	4	MID	Not available		United States	1854	1872	1	0
Ragan's Yellow	4	CEN	Not available		United States	1893	1893	1	0
Rambo	1	MID-CEN-APS	NPGS	PI 588798	United States	1835	2015	32	1
Ramsdell Sweet	2	MID-CEN-APS	TOC		United States	1838	2015	5	3
Rawle's Genet	1	EARLY-MID-CEN-APS	NFC		United States	1790	2015	35	13
Rebel	4	MID	TOC		United States	1850	2015	4	0
Red and Green Sweeting	4	EARLY	TOC			1810	2015	1	0
Red apple	4	EARLY	NPGS	PI 143973	Canada	1736	2015	1	0
Red Astrachan	1	EARLY-MID-CEN-APS	NPGS	PI 589054	Russia	1816	2015	48	0
Red Beaufin	4	EARLY	Not available			1782	1782	1	0
Red Calville	2	EARLY-MID	NFC		France	1500	1835	2	0
Red Canada	1	EARLY-MID-CEN-APS	NPGS	PI 589265	United States	1822	2015	10	1
Red Cheek Pippin	1	MID-CEN-APS	Not available		United States	1848	1909	11	3
Red Crab	4	EARLY	TOC			1804	2015	1	0
Red Gilliflower	1	EARLY-MID-CEN-APS	NPGS	PI 588973	United States	1700	2015	13	7
Red Pearmain	4	CEN	Not available		United States	1870	1902	2	0
Red Quarrendon	2	EARLY-MID	NFC		France	1678	2015	1	0
Red Streak	1	EARLY-MID-CEN	NPGS	PI 175543	United Kingdom	1600	2015	8	4

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Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
Red Stripe	3	MID-APS	Not available		United States	1867	1909	2	1
Red Westfield	4	MID	NPGS	PI 589048	United States	1835	2015	1	0
Seek-no-Further									
Red Winter	2	MID-CEN-APS	Veteto and Carlson		United States	1830	2015	9	5
Reinette Doree	2	EARLY-MID-APS	NFC	PI 136602	France	1740	2015	2	0
Reinette Grise	4	EARLY	TOC		France	1600	2015	1	0
Repka Malenka	3	CEN-APS	Not available		United States	1900	1909	2	1
Republican Pippin	4	MID	TOC		United States	1848	2015	1	0
Rhenish Pippin	4	EARLY	Not available			1782	1782	1	0
Rhode Island Greening	1	EARLY-MID-CEN-APS	NPGS	PI 589520	United States	1650	2015	41	2
Ribston	1	EARLY-MID-CEN-APS	NPGS	PI 588840	United Kingdom	1707	2015	7	2
Richmond	4	MID	Not available		United States	1854	1895	1	0
Ridge Pippin	4	MID	Not available		United States	1833	1905	1	0
Roberson	4	MID	Not available		United States	1859	1905	1	0
Rock Pippin	4	MID	Not available		United States	1833	1872	1	0
Rolen's Keeper	4	MID	Not available		United States	1867	1867	1	0
Rolfe	3	EARLY-APS	TOC		United States	1820	2015	1	0
Rome Beauty	1	EARLY-MID-CEN-APS	NPGS	PI 588850	United States	1816	2015	32	0
Rose	4	EARLY	Not available			1810	1810	1	0
Rose-Water Russet	4	EARLY	Not available			1782	1782	1	0
Rosy Red	4	MID	Not available		United States	1867	1883	1	0
Roxbury Russet	1	EARLY-MID-CEN-APS	NPGS	PI 588971	United States	1600	2015	23	1
Royal Limber Twig	4	CEN	Commercial		United States	1896	2015	4	0
Royal Pearmain	2	EARLY-MID	Not available		United States	1665	1895	6	1
Royal Russet	4	EARLY	NFC	PI 132531	United States	1597	2015	3	2
Royal Wildings	4	EARLY	TOC			1784	2015	1	0
Ruffin's large cheese apple	4	EARLY	Not available			1755	1755	1	0
Rustycroat Milam	4	MID	Commercial		United States	1867	2015	1	0
Rutledge	2	MID-CEN-APS	Not available		United States	1867	1909	2	0
Saint Johnsbury	4	APS (CEN)	Not available		United States	1909	1909	1	0
Saint Lawrence	1	MID-CEN-APS	NPGS	PI 589129	Canada	1835	2015	10	1
Sally Gray's Apple	4	EARLY	TOC			1763	2015	1	0
Salome	1	MID-CEN-APS	NPGS	PI 589083	United States	1853	2015	18	0
Saltonstall	4	MID	Not available			1858	1858	1	0
San Jacinto	4	CEN	NPGS	PI 613814	United States	1895	2015	2	0
Sauta	4	MID	Not available		United States	1850	1893	1	0
Sawyer Sweeting	4	MID	Not available		United States	1835	1835	1	0
Saxon	4	CEN	Not available			1883	1891	1	0
Scarlet Pearmain	2	EARLY-MID	NFC		England	1782	2015	2	1
Scarlet Russet	4	EARLY	Not available		United States	1782	1883	1	0
Scarlet Sweet	4	MID	Not available		United States	1867	1872	1	0
Scott's Winter	2	MID-CEN-APS	TOC		United States	1864	2015	4	1

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Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
Seager	2	EARLY-MID	Not available		United States	1760	1882	1	0
Selma	4	MID	Not available		United States	1854	1858	1	0
Senator	3	CEN-APS	NPGS	PI 590022	United States	1904	2015	4	1
September	4	MID	NPGS	PI 589058	United States	1867	2015	1	0
Setwood's Rennet	4	EARLY	Not available			1782	1782	1	0
Shackleford	4	CEN	Not available		United States	1883	1895	3	0
Shampion	4	CEN	Not available		United States	1907	1907	1	0
Shepherd's Perfection	4	CEN	Not available		United States	1906	1906	1	0
Sheriff	4	CEN	Not available		United States	1903	1904	2	0
Shiawassee Beauty	2	MID-CEN-APS	Tower Hill		United States	1850	2015	4	2
Shockley	1	MID-CEN-APS	TOC		United States	1852	2015	12	0
Shrinetown Pippin	4	CEN	Not available		United States	1905	1905	1	0
Sierra Beauty	4	CEN	TOC		United States	1890	2015	1	0
Simmons' Red	4	MID	Not available		United States	1840	1900	2	1
Sinequanon	4	MID	TOC		United States	1831	2015	1	0
Skinner's Pippin	3	CEN-APS	Not available		United States	1888	1909	6	1
Smith's Cider	1	EARLY-MID-CEN-APS	TOC		United States	1776	2015	24	2
Snepps'	4	MID	Not available		United States	1867	1872	1	0
Somersetshire	4	EARLY	Not available			1754	1754	1	0
Sonoma	4	CEN	Not available		United States	1894	1909	2	0
Sops of Wine	1	MID-CEN-APS	NFC		United States	1832	2015	16	3
Spafford Russet	4	MID	Not available		United States	1867	1872	1	0
Spark's Late	4	MID	Not available		United States	1855	1872	1	0
Spencer's Pippin	4	EARLY	Veteto and Carlson		United States	1782	2015	1	0
Spice Apple	1	EARLY-MID-CEN	TOC		United States	1782	2015	7	4
Spring Hill Pippin	4	MID	Not available			1858	1858	1	0
Spring Hill Spitzenburgh	4	MID	Not available			1858	1858	1	0
Springdale	4	CEN	TOC		United States	1894	2015	1	0
Staat	4	EARLY	Not available		United States	1810	1810	1	0
Stanard	2	MID-CEN	Not available		United States	1867	1895	2	0
Stark	1	EARLY-MID-CEN-APS	NPGS	PI 588950	United States	1810	2015	23	1
Starkley	4	APS (CEN)	Not available		United States	1909	1909	1	0
Starr	3	CEN-APS	NFC		United States	1878	2015	5	0
Stayman's Winesap	2	MID-CEN-APS	NPGS	PI 589888	United States	1866	2015	5	1
Stevenson's Winter	2	MID-CEN-APS	Not available		United States	1860	1909	2	1
Stone	4	APS (CEN)	NFC		United States	1909	2015	1	0
Strawberry June	4	CEN	Not available		United States	1892	1907	2	1
Striped Gilliflower	4	MID	Not available		United States	1867	1867	1	0
Striped July	4	CEN	Not available		United States	1874	1893	1	0
Stroat	2	EARLY-MID	Not available		United States	1826	1905	1	0
Stump	4	CEN	TOC		United States	1870	2015	7	0
Styre	4	EARLY	Not available		England	1810	1810	1	0

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Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
Sugar Loaf	4	MID	TOC		United States	1858	2015	1	0
Summer Codling	4	EARLY	Not available		England	1755	1815	2	0
Summer Extra	4	APS (CEN)	Not available		United States	1909	1909	1	0
Summer Hagloe	1	EARLY-MID-CEN-APS	Not available		United States	1817	1909	2	0
Summer Janet	4	MID	Not available		United States	1867	1867	1	0
Summer Limbertwig	4	MID	Veteto and Carlson		United States	1867	2015	1	0
Summer Primative	4	EARLY	Not available			1782	1782	1	0
Summer Queen	1	EARLY-MID-CEN-APS	TOC		United States	1782	2015	22	1
Summer Rose	1	EARLY-MID-CEN-APS	NFC		United States	1806	2015	7	0
Summer Russet	4	EARLY	Not available		United States	1782	1864	2	0
Summer Sweet Paradise	2	MID-CEN	Not available		United States	1848	1905	9	3
Superb Sweet	4	MID	Not available		United States	1845	1895	1	0
Surprise	4	MID	NPGS	PI 134672		1831	2015	1	0
Sutton's Beauty	1	EARLY-MID-CEN-APS	TOC		United States	1757	2015	15	0
Swaar	1	EARLY-MID-CEN-APS	NFC		United States	1771	2015	11	0
Swayzie	4	APS (CEN)	TOC		United States	1909	2015	1	0
Sweet and Sour	2	EARLY-MID	Not available		United States	1817	1909	1	0
Sweet Bellflower	4	MID	Not available		United States	1867	1872	1	0
Sweet Bough	1	EARLY-MID-CEN-APS	NPGS	PI 589101	United States	1817	2015	27	4
Sweet Janet	4	MID	TOC		United States	1867	2015	1	0
Sweet Limbertwig	4	CEN	Not available		United States	1893	1893	1	0
Sweet Pear	4	MID	Not available		United States	1867	1872	1	0
Sweet Pearmain	4	MID	Not available		United States	1842	1872	1	0
Sweet Pippin	4	EARLY	NPGS	PI 134672		1810	2015	1	0
Sweet Romanite	4	MID	Not available		United States	1854	1884	1	0
Sweet Russet	2	EARLY-MID	TOC		United States	1804	2015	2	0
Sweet Sponge	4	MID	Not available		United States	1867	1867	1	0
Sweet Vandervere	4	MID	Not available			1867	1894	3	1
Sweet Winesap	2	MID-CEN-APS	NPGS	PI 589295	United States	1867	2015	3	1
Switzer	4	APS (MID)	TOC		United States	1867	2015	1	0
Sylvester	4	MID	Not available		United States	1867	1867	1	0
Talbot Pippin	4	CEN	Not available		United States	1880	1892	1	0
Taliaferro	2	EARLY-MID	TOC		United States	1769	2015	3	0
Talman's Sweeting	1	EARLY-MID-CEN-APS	NPGS	PI 588805	United States	1822	2015	30	6
Taunton	2	MID-CEN-APS	TOC		United States	1858	2015	3	1
Ten Shillings	4	EARLY	Not available			1782	1934	1	0
Tender Skin	4	MID	TOC		United States	1858	2015	1	0
Terry Winter	4	APS (MID)	Commercial		United States	1868	2015	1	0
Tetofsky	1	MID-CEN-APS	TOC		Russia	1835	2015	23	3
Tewksbury Winter blush	1	EARLY-MID-CEN	Not available		United States	1817	1905	3	0
Thaler	4	CEN	Not available		Russia	1888	1904	3	1

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Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
The Cook's Favorite	4	MID	Not available		United States	1867	1867	1	0
Titovka	4	APS (CEN)	NFC		Russia	1876	2015	1	0
Tobias Rauch	4	CEN	Not available		United States	1903	1903	1	0
Toccoa	4	MID	Not available		United States	1867	1872	1	0
Townsend	2	EARLY-MID-APS	Not available		United States	1760	1909	3	2
Trader's Fancy	4	MID	Not available		United States	1867	1882	1	0
Transport	4	MID	Not available		United States	1867	1872	1	0
Triangle	4	MID	Not available		United States	1835	1835	1	0
Truman's Pearmain	4	EARLY	Not available		United States	1804	1804	1	0
Trumbull Sweeting	2	MID-CEN	Not available		United States	1854	1890	2	1
Tweksbury Winter	4	CEN	Not available		United States	1905	1905	1	0
Twenty Ounce	1	MID-CEN-APS	NPGS	PI 589007	United States	1835	2015	27	4
University	4	APS (CEN)	Not available		United States	1909	1909	1	0
Utter's Large Red	2	MID-CEN-APS	Tower Hill		United States	1855	2015	6	2
Vacaville	4	APS (CEN)	Not available		United States	1909	1909	1	0
Vance's Harvest	4	MID	Not available		United States	1867	1872	1	0
Vandervere	1	EARLY-MID-CEN-APS	NPGS	PI 589060	United States	1769	2015	24	7
Vandevils	4	EARLY	Not available		United States	1790	1790	1	0
Vanhoy	4	APS (CEN)	Not available		United States	1909	1909	1	0
Vaughan's Winter	4	MID	Not available		United States	1867	1872	1	0
Victuals and Drink	4	EARLY	Not available		United States	1750	1905	1	0
Virginia Beauty	1	EARLY-MID-CEN-APS	TOC		United States	1810	2015	3	0
Virginia Crab Apple	2	EARLY-MID	NPGS	PI 589324	United States	1790	2015	2	0
Virginia Greening	1	EARLY-MID-CEN-APS	TOC		United States	1700	2015	7	0
Virginia Quaker	4	MID	Not available		United States	1867	1872	1	0
Virginia White	4	EARLY	Not available		United States	1769	1782	2	0
Virgo	4	EARLY	Not available		United States	1782	1782	1	0
Voss' Winter	4	MID	Not available		United States	1867	1872	1	0
Wagener	1	EARLY-MID-CEN-APS	NPGS	PI 588988	United States	1791	2015	24	0
Walbridge	1	EARLY-MID-CEN-APS	Not available		United States	1818	1909	21	0
Walker Late	4	CEN	Not available		United States	1905	1905	1	0
Walker's Yellow	4	MID	Not available		United States	1858	1858	1	0
Warfield	4	MID	Not available		United States	1867	1904	1	0
Warlock's Cheese	4	EARLY	Not available		United States	1798	1798	1	0
Washington Strawberry	4	APS (MID)	NPGS	PI 589095	United States	1849	2015	1	0
Watson	4	APS (MID)	Not available		United States	1850	1909	1	0
Waxen	2	MID-CEN	TOC		United States	1835	2015	4	2
Wealthy	1	MID-CEN-APS	NPGS	PI 588788	United States	1860	2015	38	0
Weaverham Russet	4	EARLY	Not available		United States	1782	1782	1	0
Wells' Sweeting	4	MID	Not available		United States	1850	1895	1	0
West Chester	4	EARLY	NPGS	PI 589074	United States	1810	2015	1	0

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Supplemental Table 2. Continued.

Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
Westbrook's Sammons's	4	EARLY	Not available			1763	1763	1	0
Western Spy	4	MID	Not available		United States	1867	1867	1	0
Whinnery Late Red	4	CEN	Not available		United States	1893	1893	1	0
White Astrachan	1	EARLY-MID-CEN-APS	NPGS	PI 644161	Former Soviet Union	1748	2015	4	0
White Paradise	4	EARLY	Not available		Scotland	1810	1810	1	0
White Pigeon	4	APS (CEN)	Not available		United States	1909	1909	1	0
White Pippin	1	EARLY-MID-CEN-APS	NFC		United States	1790	2015	8	1
White Red Speck	4	EARLY	Not available			1810	1810	1	0
White Sour	4	EARLY	Not available			1810	1810	1	0
White Spanish Reinette	2	EARLY-MID	Not available		Spain	1600	1858	2	1
White Spitzenburg	4	MID	Not available		United States	1835	1884	1	0
White Stone Pippin	4	EARLY	NPGS	PI 133750	United Kingdom	1782	2015	1	0
White Swan	4	EARLY	Not available		Russia	1754	1754	1	0
White winter pearmain	1	EARLY-MID-CEN-APS	NPGS	PI 613887	United Kingdom	1200	2015	16	0
Whitefour	4	EARLY	Not available			1754	1754	1	0
Whitmore's Pippin	4	EARLY	Not available			1807	1884	1	0
Whitney Russet	4	MID	NPGS	PI 589194	United States	1867	2015	1	0
Wick Pearmain	4	EARLY	Not available			1782	1782	1	0
Williams	1	EARLY-MID-CEN-APS	NPGS	PI 589133	United States	1750	2015	12	2
Willis Russet	4	MID	Not available		United States	1867	1884	1	0
Willis Sweet	2	EARLY-MID	Not available		United States	1800	1905	1	0
Willow Twig	1	MID-CEN-APS	Commercial		United States	1848	2015	11	1
Wilson	2	EARLY-MID	Not available		United States	1740	1867	3	1
Windham Russet	4	APS (MID)	Not available		United States	1869	1909	1	0
Windsor Chief	4	APS (CEN)	Not available		United States	1909	1909	1	0
Winesap	1	EARLY-MID-CEN-APS	NPGS	PI 588799	United States	1804	2015	46	2
Wing Sweet	4	MID	Not available		United States	1867	1872	1	0
Winter Banana	1	CEN-APS	NPGS	PI 588861	United States	1876	2015	13	3
Winter Cheese	4	EARLY	TOC		United States	1804	2015	1	0
Winter Codling	4	EARLY	Not available		United States	1755	1831	1	0
Winter Majetin	1	EARLY-MID-CEN	NPGS	PI 589645	United Kingdom	1820	2015	1	0
Winter May	4	CEN	TOC		United States	1895	2015	1	0
Winter Russet	4	CEN	Not available		England	1883	1905	1	0
Winter Saint Lawrence	4	APS (CEN)	TOC		United States	1909	2015	1	0
Winter Streiffing	1	EARLY-MID-CEN	Not available		Germany	1796	1903	1	0
Winter Sweet Paradise	1	EARLY-MID-CEN-APS	TOC	PI 589001	United States	1798	2015	6	2
Winter Sweeting	4	MID	Not available		United States	1835	1835	1	0
Winterstein	4	CEN	TOC		United States	1902	2015	3	0
Wisconsin Russet	4	CEN	Not available		United States	1903	1903	1	0
Wisner's Dessert	4	APS (CEN)	TOC		Canada	1897	2015	1	0
Wolf River	1	CEN-APS	NPGS	PI 588807	United States	1875	2015	25	0
Woodcock	4	EARLY	NFC		England	1754	1885	2	1

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Supplemental Table 2. Continued.

Standardized name	Category ^z	Classification ^y	Availability ^x	NPGS ID	Original country	Init. date	Latest date	Publication sources (no.)	Synonyms (no.)
Wood's Favorite	4	MID	Not available		United States	1856	1898	2	0
Woolfolds	4	MID	Not available		United States	1867	1872	1	0
Wright's Janet	4	MID	Not available		United States	1867	1872	1	0
Wythe	4	APS (MID)	Not available		United States	1867	1909	1	0
Yadkin	4	MID	TOC		United States	1867	2015	1	0
Yahnke	4	APS (CEN)	Not available		United States	1909	1909	1	0
Yahooola	4	MID	Not available		United States	1858	1884	1	0
Yates	2	MID-CEN-APS	TOC		United States	1844	2015	5	0
Yellow Bellflower	1	EARLY-MID-CEN-APS	NPGS	PI 589195	United States	1742	2015	55	16
Yellow Forest	4	CEN	Not available		United States	1887	1892	1	0
Yellow Foster	4	MID	Not available		United States	1867	1867	1	0
Yellow Ingestrie	2	EARLY-MID	NFC		England	1800	2015	2	0
Yellow Sweet	2	MID-CEN-APS	NPGS	PI 589612	Former Soviet Union	1867	2015	2	1
Yellow Transparent	1	MID-CEN-APS	NPGS	PI 588859	Russia	1850	2015	38	1
York Imperial	1	MID-CEN-APS	NPGS	PI 589909	United States	1830	2015	32	3
York Russetting	4	MID	Not available		United States	1835	1905	1	0
York Stripe	4	CEN	Not available		United States	1904	1905	2	0
York Sweet Water	4	MID	Not available		United States	1835	1835	1	0

^zCategory 1 apple cultivars were present in at least 10 of the 49 nursery catalogs dated between 1888 and 1907 or identified in at least three time periods in the literature (before 1830, between 1830 and 1869, and between 1870 and 1907). Category 2 cultivars were identified in the literature in at least two time periods (either before 1830 and between 1830 and 1869, or between 1830 and 1869 and between 1870 and 1907). Category 3 cultivars were only found in the literature in one time period (before 1830, between 1830 and 1869, or between 1870 and 1907) and were also recommended by the American Pomological Society (APS). Category 4 cultivars were found only in the literature in one time period (before 1830, between 1830 and 1869, or between 1870 and 1907) but were not included in the APS recommendations. Category 4 cultivars were also those that were listed in the APS recommendations, but not documented in the literature.

^yEARLY = before 1830; MID = 1830–69; CEN = 1870–1907.

^xNFC = National Fruit Collection, Brodgate, UK; NPGS = U.S. Department of Agriculture, Agricultural Research Service National Plant Germplasm System; TOC = Temperate Orchard Conservancy, Molalla, OR; Tower Hill = Tower Hill Botanic Garden, Boylston, MA; Veteto and Carlson = Veteto and Carlson, 2014.