[Template:About](/wiki/Template:About" \o "Template:About) [Template:Redirect](/wiki/Template:Redirect) [Template:Pp-semi-indef](/wiki/Template:Pp-semi-indef) [Template:Pp-move-indef](/wiki/Template:Pp-move-indef) [Template:Use dmy dates](/wiki/Template:Use_dmy_dates) [Template:Good article](/wiki/Template:Good_article) [Template:Taxobox](/wiki/Template:Taxobox) The **apple tree** (*Malus domestica*) is a [deciduous](/wiki/Deciduous) [tree](/wiki/Tree) in the [rose family](/wiki/Rosaceae) best known for its sweet, [pomaceous](/wiki/Pome) [fruit](/wiki/Fruit), the **apple**. It is [cultivated](/wiki/Agriculture) worldwide as a [fruit tree](/wiki/Fruit_tree), and is the most widely grown species in the [genus](/wiki/Genus) [*Malus*](/wiki/Malus)*.* The tree originated in [Central Asia](/wiki/Central_Asia), where its wild ancestor, [*Malus sieversii*](/wiki/Malus_sieversii), is still found today. Apples have been grown for thousands of years in Asia and Europe, and were brought to North America by European colonists. Apples have [religious](/wiki/Religion) and [mythological](/wiki/Mythology) significance in many cultures, including [Norse](/wiki/Norse_mythology), [Greek](/wiki/Greek_mythology) and European Christian traditions.

Apple trees are large if grown from seed, but small if grafted onto roots (rootstock). There are more than 7,500 known [cultivars of apples](/wiki/List_of_apple_cultivars), resulting in a range of desired characteristics. Different cultivars are bred for various tastes and uses, including [cooking](/wiki/Cooking_apple), eating raw and [cider](/wiki/Apple_cider) production. Apples are generally propagated by [grafting](/wiki/Grafting), although wild apples grow readily from seed. Trees and fruit are prone to a number of [fungal](/wiki/Fungus), [bacterial](/wiki/Bacteria) and pest problems, which can be controlled by a number of [organic](/wiki/Organic_farming) and non-organic means. In 2010, the fruit's [genome](/wiki/Genome) was [sequenced](/wiki/DNA_sequencing) as part of research on disease control and selective breeding in apple production.

Worldwide production of apples in 2013 was 80.8 million [tonnes](/wiki/Tonnes), with China accounting for 49% of the total.<ref name=faostat/>

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## Botanical information[[edit](/index.php?title=(none)&action=edit&section=1)]

[thumb|right|Blossoms, fruits, and leaves of the apple tree (*Malus domestica*)](/wiki/File:Koeh-108.jpg) The apple is a [deciduous](/wiki/Deciduous) tree, generally standing [Template:Convert](/wiki/Template:Convert) tall in cultivation and up to [Template:Convert](/wiki/Template:Convert) in the wild.[[1]](#cite_note-1) When cultivated, the size, shape and branch density are determined by [rootstock](/wiki/Rootstock) selection and trimming method. The [leaves](/wiki/Leaf) are [alternately arranged](/wiki/Leaf_arrangement) dark green-colored simple ovals with serrated margins and slightly downy undersides.<ref name=app/>

[Blossoms](/wiki/Blossoms) are produced in spring simultaneously with the budding of the leaves, and are produced on spurs and some long shoots. The [Template:Convert](/wiki/Template:Convert) flowers are white with a pink tinge that gradually fades, five [petaled](/wiki/Petal), with an [inflorescence](/wiki/Inflorescence) consisting of a [cyme](/wiki/Cyme_(botany)) with 4–6 flowers. The central flower of the inflorescence is called the "king bloom"; it opens first, and can develop a larger fruit.<ref name=app/>[[2]](#cite_note-2) The fruit matures in late summer or autumn, and varieties exist with a wide range of sizes. Commercial growers aim to produce an apple that is [Template:Convert](/wiki/Template:Convert) in diameter, due to market preference. Some consumers, especially those in Japan, prefer a larger apple, while apples below [Template:Convert](/wiki/Template:Convert) are generally used for making juice and have little fresh market value. The skin of ripe apples is generally red, yellow, green, pink, or russetted although many bi- or tri-colored varieties may be found.<ref name=Janick>[Template:Cite book](/wiki/Template:Cite_book)</ref> The skin may also be wholly or partly russeted i.e. rough and brown. The skin is covered in a protective layer of [epicuticular wax](/wiki/Epicuticular_wax),[[3]](#cite_note-3) The flesh is generally pale yellowish-white,<ref name=Janick/> though pink or yellow flesh is also known.

### Wild ancestors[[edit](/index.php?title=(none)&action=edit&section=2)]

[Template:Main](/wiki/Template:Main) The original wild [ancestor](/wiki/Ancestor) of *Malus domestica* was *Malus sieversii*, found growing wild in the mountains of Central Asia in southern Kazakhstan, Kyrgyzstan, Tajikistan, and [Xinjiang](/wiki/Xinjiang), China.[[4]](#cite_note-4) Cultivation of the species, most likely beginning on the forested flanks of the [Tian Shan](/wiki/Tian_Shan) mountains, progressed over a long period of time and permitted secondary [introgression](/wiki/Introgression) of genes from other species into the open-pollinated seeds. Significant exchange with [*Malus sylvestris*](/wiki/Malus_sylvestris), the crabapple, resulted in current populations of apples being more related to crabapples than to the more morphologically similar progenitor *Malus sieversii*. In strains without recent admixture the contribution of the latter predominates.[[5]](#cite_note-5)[[6]](#cite_note-6)[[7]](#cite_note-7)

### Genome[[edit](/index.php?title=(none)&action=edit&section=3)]

In 2010, an Italian-led consortium announced they had sequenced the complete [genome](/wiki/Genome) of the apple in collaboration with horticultural genomicists at [Washington State University](/wiki/Washington_State_University),[[8]](#cite_note-8) using the [Golden delicious](/wiki/Golden_delicious) variety.[[9]](#cite_note-9) It had about 57,000 genes, the highest number of any plant genome studied to date[[10]](#cite_note-10) and more genes than the human genome (about 30,000).[[11]](#cite_note-11) This new understanding of the apple genome will help scientists in identifying genes and gene variants that contribute to resistance to disease and drought, and other desirable characteristics. Understanding the genes behind these characteristics will allow scientists to perform more knowledgeable selective breeding. The genome sequence also provided proof that *Malus sieversii* was the wild ancestor of the domestic apple—an issue that had been long-debated in the scientific community.[[8]](#cite_note-8)

## History[[edit](/index.php?title=(none)&action=edit&section=4)]

[thumb|Wild *Malus sieversii* apple in Kazakhstan](/wiki/File:95apple.jpeg) The center of diversity of the genus [*Malus*](/wiki/Malus) is in eastern present-day [Turkey](/wiki/Turkey). The apple tree was perhaps the earliest tree to be cultivated,<ref name=app6/> and its fruits have been improved through selection over thousands of years. [Alexander the Great](/wiki/Alexander_the_Great) is credited with finding dwarfed apples in [Kazakhstan](/wiki/Kazakhstan) in 328 [BCE](/wiki/BCE);<ref name=app/> those he brought back to Macedonia might have been the progenitors of dwarfing root stocks. Winter apples, picked in late autumn and stored just above freezing, have been an important food in Asia and Europe for millennia.<ref name=app6>[Template:Cite web](/wiki/Template:Cite_web)</ref>

Apples were introduced to North America by colonists in the 17th century,<ref name=app/> and the first apple orchard on the North American continent was planted in [Boston](/wiki/Boston) by Reverend [William Blaxton](/wiki/William_Blaxton) in 1625.[[12]](#cite_note-12) The only apples native to North America are [crab apples](/wiki/Crab_apples), which were once called "common apples".[[13]](#cite_note-13) Apple varieties brought as seed from Europe were spread along Native American trade routes, as well as being cultivated on Colonial farms. An 1845 United States apples nursery catalogue sold 350 of the "best" varieties, showing the proliferation of new North American varieties by the early 19th century.[[13]](#cite_note-13) In the 20th century, irrigation projects in [Eastern Washington](/wiki/Eastern_Washington) began and allowed the development of the multibillion-dollar fruit industry, of which the apple is the leading product.<ref name=app/>

Until the 20th century, farmers stored apples in [frostproof cellars](/wiki/Root_cellar) during the winter for their own use or for sale. Improved transportation of fresh apples by train and road replaced the necessity for storage.[[14]](#cite_note-14)[[15]](#cite_note-15) In the 21st century, long-term storage again came into popularity, as "controlled atmosphere" facilities were used to keep apples fresh year-round. Controlled atmosphere facilities use high humidity, low oxygen, and controlled carbon dioxide levels to maintain fruit freshness.[[16]](#cite_note-16)[[17]](#cite_note-17)<ref name=book2>[Template:Cite book](/wiki/Template:Cite_book)</ref>[[22]](#cite_note-22) The Greek goddess of discord, [Eris](/wiki/Eris_(mythology)), became disgruntled after she was excluded from the wedding of [Peleus](/wiki/Peleus) and [Thetis](/wiki/Thetis).[[23]](#cite_note-23) In retaliation, she tossed a golden apple inscribed [Καλλίστη](/wiki/Kallisti) (*Kalliste*, sometimes transliterated *Kallisti*, 'For the most beautiful one'), into the wedding party. Three goddesses claimed the apple: [Hera](/wiki/Hera), [Athena](/wiki/Athena), and [Aphrodite](/wiki/Aphrodite). [Paris](/wiki/Paris_(mythology)) of [Troy](/wiki/Troy) was appointed to select the recipient. After being bribed by both Hera and Athena, Aphrodite tempted him with the most beautiful woman in the world, [Helen](/wiki/Helen_of_Troy) of [Sparta](/wiki/Sparta). He awarded the apple to Aphrodite, thus indirectly causing the [Trojan War](/wiki/Trojan_War).

The apple was thus considered, in ancient Greece, to be sacred to Aphrodite, and to throw an apple at someone was to symbolically declare one's love; and similarly, to catch it was to symbolically show one's acceptance of that love.[[24]](#cite_note-24) An epigram claiming authorship by Plato states:

[Template:Quote](/wiki/Template:Quote)

[Atalanta](/wiki/Atalanta), also of Greek mythology, raced all her suitors in an attempt to avoid marriage. She outran all but [Hippomenes](/wiki/Hippomenes) (also known as [Melanion](/wiki/Melanion), a name possibly derived from *melon* the Greek word for both "apple" and fruit in general),<ref name=book2/> who defeated her by cunning, not speed. Hippomenes knew that he could not win in a fair race, so he used three golden apples (gifts of Aphrodite, the goddess of love) to distract Atalanta. It took all three apples and all of his speed, but Hippomenes was finally successful, winning the race and Atalanta's hand.<ref name=book1/>

### Christian art[[edit](/index.php?title=(none)&action=edit&section=8)]

[thumb|](/wiki/File:Albrecht_Dürer_-_Adam_and_Eve_(Prado)_2.jpg)[*Adam and Eve*](/wiki/Adam_and_Eve) by [Albrecht Dürer](/wiki/Albrecht_Dürer) (1507), showcasing the apple as a symbol of sin.

Though the forbidden fruit of [Eden](/wiki/Garden_of_Eden) in the [Book of Genesis](/wiki/Book_of_Genesis) is not identified, popular Christian tradition has held that it was an apple that [Eve](/wiki/Adam_and_Eve) coaxed [Adam](/wiki/Adam_and_Eve) to share with her.[[25]](#cite_note-25) The origin of the popular identification with a fruit unknown in the Middle East in biblical times is found in confusion between the [Latin](/wiki/Latin_language) words *mālum* (an apple) and *mălum* (an evil), each of which is normally written *malum*.[[26]](#cite_note-26) The tree of the forbidden fruit is called "the tree of the knowledge of good and evil" in [Template:Bibleverse](/wiki/Template:Bibleverse), and the Latin for "good and evil" is *bonum et malum*.[[27]](#cite_note-27) [Renaissance](/wiki/Renaissance) painters may also have been influenced by the story of the [golden apples](/wiki/Golden_apple) in the [Garden of Hesperides](/wiki/Hesperides#The_Garden_of_the_Hesperides). As a result, in the story of Adam and Eve, the apple became a symbol for knowledge, immortality, temptation, the fall of man into sin, and sin itself. The [larynx](/wiki/Larynx) in the human throat has been called [Adam's apple](/wiki/Adam's_apple) because of a notion that it was caused by the forbidden fruit remaining in the throat of Adam.[[25]](#cite_note-25) The apple as symbol of sexual [seduction](/wiki/Seduction) has been used to imply human sexuality, possibly in an ironic vein.<ref name=book7/>

## Cultivars[[edit](/index.php?title=(none)&action=edit&section=9)]

[Template:Main](/wiki/Template:Main) [thumb|right|Red and green apples in India](/wiki/File:Red_and_Green_apples_in_India.jpg) There are more than 7,500 known [cultivars](/wiki/Cultivar) of apples.[[28]](#cite_note-28) Cultivars vary in their [yield](/wiki/Crop_yield) and the ultimate size of the tree, even when grown on the same [rootstock](/wiki/Rootstock).<ref name=England/> Different cultivars are available for [temperate](/wiki/Temperate) and [subtropical](/wiki/Subtropical) climates. The UK's National Fruit Collection, which is the responsibility of the Department of Environment Food and Rural Affairs, includes a collection of over 2,000 varieties of apple tree in Kent.[[29]](#cite_note-29) The University of Reading, which is responsible for developing the UK national collection database, provides access to search the national collection. The University of Reading's work is part of the European Cooperative Programme for Plant Genetic Resources of which there are 38 countries participating in the Malus/Pyrus work group.[[30]](#cite_note-30) The UK's national fruit collection database contains a wealth of information on the characteristics and origin of many apples, including alternative names for what is essentially the same 'genetic' apple variety. Most of these cultivars are bred for eating fresh (dessert apples), though some are cultivated specifically for cooking ([cooking apples](/wiki/Cooking_apple)) or producing [cider](/wiki/Cider). [Cider apples](/wiki/Cider_apple) are typically too tart and astringent to eat fresh, but they give the beverage a rich flavor that dessert apples cannot.[[31]](#cite_note-31) Commercially popular apple cultivars are soft but crisp. Other desired qualities in modern commercial apple breeding are a colorful skin, absence of [russeting](/wiki/Russet_apple), ease of shipping, lengthy storage ability, high yields, disease resistance, common apple shape, and developed flavor.[[32]](#cite_note-32) Modern apples are generally sweeter than older cultivars, as popular tastes in apples have varied over time. Most North Americans and Europeans favor sweet, subacid apples, but tart apples have a strong minority following.<ref name=World/> Extremely sweet apples with barely any acid flavor are popular in Asia<ref name=World>[Template:Cite web](/wiki/Template:Cite_web)</ref> and especially [Indian Subcontinent](/wiki/Indian_Subcontinent) .<ref name=apples1/>

Old cultivars are often oddly shaped, russeted, and have a variety of textures and colors. Some find them to have a better flavor than modern cultivars,[[33]](#cite_note-33) but they may have other problems which make them commercially unviable from low yield, disease susceptibility, poor tolerance for storage or transport, or just being the 'wrong' size. A few old cultivars are still produced on a large scale, but many have been preserved by home gardeners and farmers that sell directly to local markets. Many unusual and locally important cultivars with their own unique taste and appearance exist; apple conservation campaigns have sprung up around the world to preserve such local cultivars from extinction. In the United Kingdom, old cultivars such as '[Cox's Orange Pippin'](/wiki/Cox's_Orange_Pippin) and '[Egremont Russet'](/wiki/Egremont_Russet) are still commercially important even though by modern standards they are low yielding and susceptible to disease.<ref name=app>[Template:Cite web](/wiki/Template:Cite_web) </ref>

## Cultivation[[edit](/index.php?title=(none)&action=edit&section=10)]

### Breeding[[edit](/index.php?title=(none)&action=edit&section=11)]

[Template:See also](/wiki/Template:See_also) [thumb|An apple tree in Germany](/wiki/File:Apfelbaum_Winterrambour_Hochstamm.jpg) In the wild, apples grow readily from seeds. However, like most perennial fruits, apples are ordinarily propagated asexually by [grafting](/wiki/Grafting). This is because seedling apples are an example of "[extreme heterozygotes](/wiki/Zygosity)", in that rather than inheriting DNA from their parents to create a new apple with those characteristics, they are instead significantly different from their parents.[[34]](#cite_note-34) [Triploid](/wiki/Polyploid) varieties have an additional reproductive barrier in that 3 sets of chromosomes cannot be divided evenly during meiosis, yielding unequal segregation of the chromosomes (aneuploids). Even in the case when a triploid plant can produce a seed (apples are an example), it occurs infrequently, and seedlings rarely survive.[[35]](#cite_note-35) Because apples do not breed true when planted as seeds, [grafting](/wiki/Grafting) is generally used to produce new apple trees. The [rootstock](/wiki/Rootstock) used for the bottom of the graft can be selected to produce trees of a large variety of sizes, as well as changing the winter hardiness, insect and disease resistance, and soil preference of the resulting tree. Dwarf rootstocks can be used to produce very small trees (less than [Template:Convert](/wiki/Template:Convert) high at maturity), which bear fruit earlier in their life cycle than full size trees.[[36]](#cite_note-36) Dwarf rootstocks for apple trees can be traced as far back as 300 BC, to the area of [Persia](/wiki/Persia) and [Asia Minor](/wiki/Asia_Minor). [Alexander the Great](/wiki/Alexander_the_Great) sent samples of dwarf apple trees to [Aristotle's](/wiki/Aristotle) [Lyceum](/wiki/Lyceum). Dwarf rootstocks became common by the 15th century, and later went through several cycles of popularity and decline throughout the world.[[37]](#cite_note-37) The majority of the rootstocks used today to control size in apples were developed in England in the early 1900s. The [East Malling Research Station](/wiki/East_Malling_Research_Station) conducted extensive research into rootstocks, and today their rootstocks are given an "M" prefix to designate their origin. Rootstocks marked with an "MM" prefix are Malling-series varieties later crossed with trees of the [Northern Spy](/wiki/Northern_Spy) variety in [Merton, England](/wiki/London_Borough_of_Merton).[[38]](#cite_note-38) Most new apple cultivars originate as seedlings, which either arise by chance or are bred by deliberately crossing cultivars with promising characteristics.<ref name=book9>[Template:Cite book](/wiki/Template:Cite_book)</ref> The words 'seedling', 'pippin', and 'kernel' in the name of an apple cultivar suggest that it originated as a seedling. Apples can also form [bud sports](/wiki/Bud_sport) (mutations on a single branch). Some bud sports turn out to be improved strains of the parent cultivar. Some differ sufficiently from the parent tree to be considered new cultivars.<ref name=app4>[Template:Cite web](/wiki/Template:Cite_web)</ref>

Since the 1930s, the Excelsior Experiment Station at the [University of Minnesota](/wiki/University_of_Minnesota) has introduced a steady progression of important apples that are widely grown, both commercially and by local orchardists, throughout [Minnesota](/wiki/Minnesota) and [Wisconsin](/wiki/Wisconsin). Its most important contributions have included '[Haralson'](/wiki/Haralson_(apple)) (which is the most widely cultivated apple in Minnesota), '[Wealthy'](/wiki/Wealthy_(apple)), 'Honeygold', and '[Honeycrisp'](/wiki/Honeycrisp).

Apples have been acclimatized in Ecuador at very high altitudes, where they provide crops twice per year because of constant temperate conditions year-round.[[39]](#cite_note-39) <gallery> File:Aliceapple.JPG|**Alice** File:Berlinwohnung 03.01.2014 13-45-13.JPG|**Ambrosia** Image:Malus-Ananasrenette.jpg|**Ananasrenette** File:Aroma äpplen i korg.jpeg|**Aroma** File:Discovery apples.jpg|**Discovery** Image:Brimley Apples.jpg|**Bramley** Image:Arkansas Black apples.jpg|**Arkansas Black** Image:Fuji apple.jpg|**Fuji** Image:Golden delicious apple.jpg|**Golden delicious** Image:Malus Goldrenette F. v. Berlepsch.jpg|**Goldrenette** Image:Red Apple.jpg|**Gala** Image:Jonagold.jpg|**Jonagold** File:Malus-James-Grieve.jpg|**James Grieve** Image:Granny smith closeup.jpg|**Granny Smith** Image:McIntosh with sticker by Lars Zapf 2006-03-30 cropped.jpg|**McIntosh** Image:Yellow Transparent.jpg|**Yellow Transparent** Image:Apple 03.jpg|**Pacific rose** Image:Lobo cultivar.jpg|**Lobo** Image:Sampion cultivar.jpg|[**Sampion**](/wiki/Champion_(apple)) (Shampion) File:Summerred.jpg|**Summerred** File:Malus-Cripps-Pink.jpg|**Pink Lady** File:Malus-Boskoop organic.jpg|**Belle de Boskoop** Image:Red Delicious.jpg|**Red Delicious** File:Malus-Cox-Pomona.jpg|**Cox Pomona** </gallery>

### Pollination[[edit](/index.php?title=(none)&action=edit&section=12)]

[Template:See also](/wiki/Template:See_also) [right|thumb|Apple blossom from an old](/wiki/File:Apple_tree_blossom.JPG) [Ayrshire](/wiki/Ayrshire) variety [thumb|](/wiki/File:Orchmason.jpg)[Orchard mason bee](/wiki/Orchard_mason_bee) on apple bloom, [British Columbia, Canada](/wiki/British_Columbia,_Canada)

Apples are self-incompatible; they must [cross-pollinate](/wiki/Pollination) to develop fruit. During the flowering each season, apple growers often utilize [pollinators](/wiki/Pollinator) to carry pollen. [Honey bees](/wiki/Honey_bee) are most commonly used. [Orchard mason bees](/wiki/Osmia_lignaria) are also used as supplemental pollinators in commercial orchards. [Bumblebee](/wiki/Bumblebee) [queens](/wiki/Queen_bee) are sometimes present in orchards, but not usually in enough quantity to be significant pollinators.[[40]](#cite_note-40) There are four to seven pollination groups in apples, depending on climate:

* Group A – Early flowering, 1 to 3 May in England ([Gravenstein](/wiki/Gravenstein), Red Astrachan)
* Group B – 4 to 7 May ([Idared](/wiki/Idared), [McIntosh](/wiki/McIntosh_(apple)))
* Group C – Mid-season flowering, 8 to 11 May ([Granny Smith](/wiki/Granny_Smith), [Cox's Orange Pippin](/wiki/Cox's_Orange_Pippin))
* Group D – Mid/late season flowering, 12 to 15 May ([Golden Delicious](/wiki/Golden_Delicious), Calville blanc d'hiver)
* Group E – Late flowering, 16 to 18 May ([Braeburn](/wiki/Braeburn), Reinette d'Orléans)
* Group F – 19 to 23 May (Suntan)
* Group H – 24 to 28 May (Court-Pendu Gris - also called Court-Pendu plat)

One cultivar can be pollinated by a compatible cultivar from the same group or close (A with A, or A with B, but not A with C or D).[[41]](#cite_note-41) Varieties are sometimes classified by the day of peak bloom in the average 30-day blossom period, with pollenizers selected from varieties within a 6-day overlap period.

### Maturation and harvest[[edit](/index.php?title=(none)&action=edit&section=13)]

[Template:See also](/wiki/Template:See_also)

Cultivars vary in their yield and the ultimate size of the tree, even when grown on the same rootstock. Some cultivars, if left unpruned, will grow very large, which allows them to bear much more fruit, but makes harvesting very difficult. Depending on the tree density (number of trees planted per unit surface area), mature trees typically bear [Template:Convert](/wiki/Template:Convert) of apples each year, though productivity can be close to zero in poor years. Apples are harvested using three-point ladders that are designed to fit amongst the branches. Trees grafted on dwarfing rootstocks will bear about [Template:Convert](/wiki/Template:Convert) of fruit per year.<ref name=app4/>

Crops ripen at different times of the year according to the variety of apple. Varieties that yield their crop in the summer include Gala, Golden Supreme, McIntosh, Transparent, Primate, [Sweet Bough](/wiki/Sweet_Bough), and Duchess; fall producers include Fuji, Jonagold, Golden Delicious, Red Delicious, Chenango, Gravenstein, Wealthy, McIntosh, Snow, and Blenheim; winter producers include Winesap, Granny Smith, King, Wagener, [Swayzie](/wiki/Swazie_(apple)), Greening, and Tolman Sweet.[[13]](#cite_note-13)

### Storage[[edit](/index.php?title=(none)&action=edit&section=14)]

Commercially, apples can be stored for some months in controlled-atmosphere chambers to delay [ethylene](/wiki/Ethylene)-induced ripening. Apples are commonly stored in chambers with higher concentrations of [carbon dioxide](/wiki/Carbon_dioxide) and high air filtration. This prevents ethylene concentrations from rising to higher amounts and preventing ripening from occurring too quickly. Ripening continues when the fruit is removed from storage.[[42]](#cite_note-42)For home storage, most varieties of apple can be held for approximately two weeks when kept at the coolest part of the refrigerator (i.e. below 5 °C). Some types, including the [Granny Smith](/wiki/Granny_Smith) and [Fuji](/wiki/Fuji_(apple)), can be stored up to a year without significant degradation.[[43]](#cite_note-43)[[44]](#cite_note-44)

### Pests and diseases[[edit](/index.php?title=(none)&action=edit&section=15)]

[thumb|Leaves with significant insect damage](/wiki/File:Apple_tree_leaves_with_insect_damage.jpg) [Template:Main](/wiki/Template:Main) [Template:See also](/wiki/Template:See_also) Apple trees are susceptible to a number of [fungal](/wiki/Fungus) and [bacterial](/wiki/Bacterium) diseases and insect pests. Many commercial orchards pursue an aggressive program of chemical sprays to maintain high fruit quality, tree health, and high yields. A trend in orchard management is the use of organic methods.[Template:Citation needed](/wiki/Template:Citation_needed) These prohibit the use of synthetic pesticides, though some older pesticides are allowed. [Organic](/wiki/Organic_farming) methods include, for instance, introducing its natural predator to reduce the population of a particular pest.

A wide range of pests and diseases can affect the plant; three of the more common diseases/pests are mildew, aphids and apple scab.

* [Mildew](/wiki/Mildew): which is characterized by light grey powdery patches appearing on the leaves, shoots and flowers, normally in spring. The flowers will turn a creamy yellow color and will not develop correctly. This can be treated in a manner not dissimilar from treating [Botrytis](/wiki/Botryotinia); eliminating the conditions which caused the disease in the first place and burning the infected plants are among the recommended actions to take.[[45]](#cite_note-45)\* [Aphids](/wiki/Aphids): There are five species of aphids commonly found on apples: apple grain aphid, rosy apple aphid, apple aphid, spirea aphid and the woolly apple aphid. The aphid species can be identified by their color, the time of year when they are present and by differences in the cornicles, which are small paired projections from the rear of aphids.<ref name=pest4/> Aphids feed on foliage using needle-like mouth parts to suck out plant juices. When present in high numbers, certain species reduce tree growth and vigor.<ref name=pest5>[Template:Cite web](/wiki/Template:Cite_web)</ref>
* [Apple scab](/wiki/Apple_scab): Apple scab causes leaves to develop olive-brown spots with a velvety texture that later turn brown and become cork-like in texture. The disease also affects the fruit, which also develops similar brown spots with velvety or cork-like textures. Apple scab is spread through fungus growing in old apple leaves on the ground and spreads during warm spring weather to infect the new year's growth.<ref name=Bradley>[Template:Cite book](/wiki/Template:Cite_book)</ref>

Among the most serious disease problems are [fireblight](/wiki/Fireblight), a bacterial disease; and [*Gymnosporangium*](/wiki/Gymnosporangium) rust, and [black spot](/wiki/Black_Spot_(disease)), two fungal diseases.<ref name=pest5/> [Codling moths](/wiki/Codling_moth) and [apple maggots](/wiki/Apple_maggot) are two other pests which affect apple trees. Young apple trees are also prone to mammal pests like mice and deer, which feed on the soft bark of the trees, especially in winter.<ref name=Bradley/>

|  |
| --- |
| **colspan=2|Apple production – 2013** |
| **Country** | **Production (millions of** [**tonnes**](/wiki/Tonne)**)** |
| [Template:CHN](/wiki/Template:CHN) ||  39.7 |  |
| [Template:USA](/wiki/Template:USA) ||  4.1 |  |
| [Template:TUR](/wiki/Template:TUR) ||  3.1 |  |
| [Template:POL](/wiki/Template:POL) ||  3.1 |  |
| [Template:ITA](/wiki/Template:ITA) ||  2.2 |  |
| **World** ||  80.8 |  |
| Source: [FAOSTAT](/wiki/FAOSTAT) of the [United Nations](/wiki/United_Nations)[[46]](#cite_note-46) | |

## Production[[edit](/index.php?title=(none)&action=edit&section=16)]

[Template:Main](/wiki/Template:Main)

World production of apples in 2013 was 80.8 million [tonnes](/wiki/Tonne), with China producing 49% of this total (table).<ref name=faostat/> Other major producers with 5% or less of the world total were the United States, Turkey, Poland and Italy.

## Nutrition[[edit](/index.php?title=(none)&action=edit&section=17)]

[Template:Nutritional value](/wiki/Template:Nutritional_value)

A typical apple serving weighs 242 grams and provides 126 [calories](/wiki/Calories) with a moderate content of [dietary fiber](/wiki/Dietary_fiber) (table).[[47]](#cite_note-47) Otherwise, there is generally low content of [essential nutrients](/wiki/Essential_nutrients) (table).

## Human consumption[[edit](/index.php?title=(none)&action=edit&section=18)]

[Template:See also](/wiki/Template:See_also) [thumb|upright|An apple core, the remainder of an apple that has been mostly eaten](/wiki/File:Apple_stark_s.jpg)

Apples are often eaten raw. The whole fruit including the skin is suitable for human consumption except for the seeds, which may affect some consumers.[Template:Citation needed](/wiki/Template:Citation_needed) The core is often not eaten and is discarded. Varieties bred for raw consumption are termed dessert or [table apples](/wiki/Table_apple).

Apples can be canned or juiced. They are milled or pressed to produce [apple juice](/wiki/Apple_juice), which may be drunk unfiltered (called [apple cider](/wiki/Apple_cider) in North America), or filtered. The juice can be [fermented](/wiki/Fermentation_(food)) to make [cider](/wiki/Cider) (called hard cider in North America), [ciderkin](/wiki/Ciderkin), and [vinegar](/wiki/Vinegar). Through [distillation](/wiki/Distillation), various alcoholic beverages can be produced, such as [applejack](/wiki/Applejack_(beverage)), [Calvados](/wiki/Calvados_(spirit)),<ref name=food/> and [apfelwein](/wiki/Apfelwein). [Apple seed oil](/wiki/Apple_seed_oil)[[48]](#cite_note-48)and [pectin](/wiki/Pectin) may also be produced.

### Popular uses[[edit](/index.php?title=(none)&action=edit&section=19)]

Apples are an important ingredient in many desserts, such as [apple pie](/wiki/Apple_pie), apple [crumble](/wiki/Crumble), [apple crisp](/wiki/Apple_crisp) and [apple cake](/wiki/Apple_cake). They are often eaten [baked](/wiki/Baked) or [stewed](/wiki/Stewed), and they can also be dried and eaten or reconstituted (soaked in water, alcohol or some other liquid) for later use. When cooked, some apple varieties easily form a puree known as [apple sauce](/wiki/Apple_sauce). Apples are also made into [apple butter](/wiki/Apple_butter) and apple jelly. They are also used (cooked) in meat dishes.

* In the UK, a [toffee apple](/wiki/Toffee_apple) is a traditional confection made by coating an apple in hot [toffee](/wiki/Toffee) and allowing it to cool. Similar treats in the U.S. are [candy apples](/wiki/Candy_apple) (coated in a hard shell of crystallized sugar syrup), and [caramel apples](/wiki/Caramel_apples), coated with cooled [caramel](/wiki/Caramel).
* Apples are eaten with honey at the Jewish New Year of [Rosh Hashanah](/wiki/Rosh_Hashanah) to symbolize a sweet new year.<ref name=food/>
* Farms with apple orchards may open them to the public, so consumers may themselves pick the apples they will purchase.<ref name=food>[Template:Cite web](/wiki/Template:Cite_web)</ref>

Sliced apples turn brown with exposure to air due to the conversion of natural phenolic substances into [melanin](/wiki/Melanin) upon exposure to [oxygen](/wiki/Oxygen).<ref name=J1/> Different cultivars vary in their propensity to brown after slicing[[49]](#cite_note-49) and the [genetically engineered](/wiki/Genetically_engineered) [Arctic Apples](/wiki/Arctic_Apples) do not brown. Sliced fruit can be treated with [acidulated water](/wiki/Acidulated_water) to prevent this effect.<ref name=J1/> Sliced apple consumption tripled in the US from 2004 to 2014 to 500 million apples annually due to its convenience.[[50]](#cite_note-50)

### Organic production[[edit](/index.php?title=(none)&action=edit&section=20)]

[Organic](/wiki/Organic_farming) apples are commonly produced in the United States.<ref name=organic>[Template:Cite web](/wiki/Template:Cite_web)</ref> Organic production is difficult in Europe, though a few orchards have done so with commercial success,<ref name=organic/> using disease-resistant cultivars. A light coating of [kaolin](/wiki/Kaolin), which forms a physical barrier to some pests, also helps prevent apple sun scalding.<ref name=app4/><ref name=organic/>

### Phytochemicals[[edit](/index.php?title=(none)&action=edit&section=21)]

Apples are a rich source of various [phytochemicals](/wiki/Phytochemical) including [flavonoids](/wiki/Flavonoid) (e.g., [catechins](/wiki/Catechin), [flavanols](/wiki/Flavanol), and [quercetin](/wiki/Quercetin)) and other [phenolic compounds](/wiki/Polyphenol) (e.g., [epicatechin](/wiki/Epicatechin) and [procyanidins](/wiki/Procyanidin))<ref name=Ribeiro2014>[Template:Cite journal](/wiki/Template:Cite_journal)</ref> found in the skin, core, and pulp of the apple;<ref name=Ribeiro2014/> they have unknown health value in humans.<ref name=J1>[Template:Cite journal](/wiki/Template:Cite_journal)</ref>

[Ideain](/wiki/Ideain) (cyanidin 3-O-galactoside) is an [anthocyanin](/wiki/Anthocyanin), a type of pigment, which is found in some red apple varieties.[[51]](#cite_note-51) [Phlorizin](/wiki/Phlorizin) is a flavonoid that is found in apple trees, particularly in the leaves, and in only small amounts if at all in other plants, even other species of the *Malus* genus or related plants such as pear trees.[[52]](#cite_note-52)

### Health effects[[edit](/index.php?title=(none)&action=edit&section=22)]

Preliminary research is investigating whether nutrients and/or phytochemicals in apples may affect the risk of some types of [cancer](/wiki/Cancer).<ref name=Ribeiro2014/>[[53]](#cite_note-53)

### Allergy[[edit](/index.php?title=(none)&action=edit&section=23)]

One form of apple allergy, often found in northern Europe, is called birch-apple syndrome, and is found in people who are also allergic to [birch](/wiki/Birch) [pollen](/wiki/Pollen).<ref name=EU/> Allergic reactions are triggered by a protein in apples that is similar to birch pollen, and people affected by this protein can also develop allergies to other fruits, nuts, and vegetables. Reactions, which entail [oral allergy syndrome](/wiki/Oral_allergy_syndrome) (OAS), generally involve itching and inflammation of the mouth and throat,<ref name=EU/> but in rare cases can also include life-threatening [anaphylaxis](/wiki/Anaphylaxis).[[54]](#cite_note-54) This reaction only occurs when raw fruit is consumed—the allergen is neutralized in the cooking process. The variety of apple, maturity and storage conditions can change the amount of allergen present in individual fruits. Long storage times can increase the amount of proteins that cause birch-apple syndrome.<ref name=EU>[Template:Cite web](/wiki/Template:Cite_web)</ref>

[Different kinds of apple](/wiki/File:MIN_Rungis_pommes.jpg) [cultivars](/wiki/List_of_apple_cultivars) in a wholesale food market|thumb|right In other areas, such as the Mediterranean, some individuals have adverse reactions to apples because of their similarity to peaches.<ref name=EU/> This form of apple allergy also includes OAS, but often has more severe symptoms, such as vomiting, abdominal pain and [urticaria](/wiki/Urticaria), and can be life-threatening. Individuals with this form of allergy can also develop reactions to other fruits and nuts. Cooking does not break down the protein causing this particular reaction, so affected individuals can eat neither raw nor cooked apples. Freshly harvested, over-ripe fruits tend to have the highest levels of the protein that causes this reaction.<ref name=EU/>

Breeding efforts have yet to produce a [hypoallergenic](/wiki/Hypoallergenic) fruit suitable for either of the two forms of apple allergy.<ref name=EU/>

### Toxicity of seeds[[edit](/index.php?title=(none)&action=edit&section=24)]

The seeds of apples contain small amounts of [amygdalin](/wiki/Amygdalin), a sugar and [cyanide](/wiki/Cyanide) compound known as a [cyanogenic glycoside](/wiki/Cyanogenic_glycoside#Cyanogenic_glycosides). Ingesting small amounts of apple seeds will cause no ill effects, but in extremely large doses can cause adverse reactions. There is only one known case of fatal cyanide poisoning from apple seeds; in this case the individual chewed and swallowed one [cup](/wiki/Cup_(unit)) of seeds. It may take several hours before the poison takes effect, as cyanogenic glycosides must be [hydrolyzed](/wiki/Hydrolyzed) before the cyanide ion is released.[[55]](#cite_note-55)

## Proverbs[[edit](/index.php?title=(none)&action=edit&section=25)]

[thumb|left|288px|An apple's stem end, side, and interior](/wiki/File:Pink_lady_and_cross_section.jpg) The [proverb](/wiki/Proverb) "[*An apple a day keeps the doctor away*](/wiki/An_apple_a_day_keeps_the_doctor_away)", addressing the health effects of the fruit, dates from 19th century Wales according to Caroline Taggart, author of “An Apple a Day: Old-Fashioned Proverbs and Why They Still Work.” The original phrase, Taggart said, was, ‘‘Eat an apple on going to bed, and you’ll keep the doctor from earning his bread.” In the 19th century and early 20th, the phrase evolved to “an apple a day, no doctor to pay” and “an apple a days sends the doctor away,” while the phrasing now commonly used was first recorded in 1922.[[56]](#cite_note-56)[Template:Clear](/wiki/Template:Clear)

## See also[[edit](/index.php?title=(none)&action=edit&section=26)]

* [Apple chips](/wiki/Apple_chips)
* [Applecrab](/wiki/Applecrab), apple–crabapple hybrids with the good eating qualities of the apple parents
* [Cooking apple](/wiki/Cooking_apple)
* [List of apple dishes](/wiki/List_of_apple_dishes)
* [Welsh Apples](/wiki/Welsh_Apples)

## References[[edit](/index.php?title=(none)&action=edit&section=27)]

[Template:Reflist](/wiki/Template:Reflist)

## Further reading[[edit](/index.php?title=(none)&action=edit&section=28)]

Books

* [Template:Cite book](/wiki/Template:Cite_book)
* [Template:Cite book](/wiki/Template:Cite_book)

## External links[[edit](/index.php?title=(none)&action=edit&section=29)]

[Template:Sister project links](/wiki/Template:Sister_project_links)

* [Apple Facts](http://www.ifr.ac.uk/info/society/spotlight/apples.htm) from the UK's [Institute of Food Research](/wiki/Institute_of_Food_Research)
* [National Fruit Collection](http://www.nationalfruitcollection.org.uk/) (UK)
* [Grand Valley State University digital collections](http://gvsu.cdmhost.com/cdm4/results.php?CISOOP1=all&CISOBOX1=&CISOFIELD1=CISOSEARCHALL&CISOOP2=exact&CISOBOX2=peticolas%2C%20theodore&CISOFIELD2=CISOSEARCHALL&CISOOP3=any&CISOBOX3=&CISOFIELD3=CISOSEARCHALL&CISOOP4=none&CISOBOX4=&CISOFIELD4=CISOSEARCHALL&CISOROOT=/p4103coll3&t=a)- diary of Ohio fruit farmer Theodore Peticolas, 1863

[Template:Apples](/wiki/Template:Apples) [Template:Crabapple](/wiki/Template:Crabapple)

[Template:Authority control](/wiki/Template:Authority_control)

[\*](/wiki/Category:Apples) [\*](/wiki/Category:Malus) [Category:Fruits originating in Asia](/wiki/Category:Fruits_originating_in_Asia) [Category:Plants described in 1803](/wiki/Category:Plants_described_in_1803)