

PEARS STORAGE



Pre- and Post-Harvest storage

TABLE OF CONTENTS

Introduction-The World’s Top Pear Producing Countries.....	3
Growing Conditions.....	3
Type of Pear Trees.....	4
Climate.....	4
Pre-harvest conditions and Harvest.....	5
Harvesting Time.....	6
Harvest Maturity.....	8
Post-harvest time and Storage.....	11
Ethylene.....	14

References from:

L.B. Gast, *Harvest Maturity*, Kansas State University, November 1994.

Eugene Kupferman
Washington State University
Tree Fruit Research and Extension Center.

- Slingerland, K., and W. MacFadden-Smith. August 2011. [Pear Production in Ontario](#). Ontario Ministry of Agriculture, Food and Rural Affairs. Factsheet Order No. 11-047.
- DeEll, J., and B. Ehsani-Moghaddam. 2011. [Timing of Postharvest 1-Methylcyclopropene Treatment Affects Bartlett Pear Quality after Storage](#). Can. J. Plant Sci. 91: 853-858.
- DeEll, J., and B. Ehsani-Moghaddam. 2010. Storage to Help Extend the Seasonal Availability of Pears. Report for CanAdvance Project ADV-635.
- DeEll, J., and K. Slingerland. 2009. Storage to Help Extend the Seasonal Availability of Pears. Report for CanAdvance Project ADV-635.
- Mitcham, E.J., and R.B. Elkins. 2007. [Pear Production and Handling Manual](#). University of California Agriculture and Natural Resources. Publication 3483.

Pears are fruits produced and consumed around the world, growing on a tree and harvested in the Northern Hemisphere in late summer into October and on the Southern hemisphere harvested in March/April. The pear tree and shrub are a species of genus *Pyrus Communis*, in the family Rosaceae, bearing the pomaceous fruit of the same name.

[China](#) is the leading producing country of pears, having produced 16.5 million tonnes of pears in 2017. [Argentina](#) is the world's second largest producer with 930,340 tonnes produced, followed by [Italy](#) (772,577) and the [United States](#) (677,891). (By Richard Jauron, Department of Horticulture).

The World's Top Pear Producing Countries

Rank	Country	Production (Tonnes)
1	China	16,527,694
2	Argentina	930,340
3	Italy	772,577
4	United States of America	677,891
5	Turkey	503,004
6	South Africa	414,879
7	Spain	360,957
8	India	346,000
9	Netherlands	330,000
10	Chile	309,189

Growing conditions

Pears can be grown in a wide range of soil and can fit within a small space making it a good choice for gardeners. Choosing the right variety is key to achieving quality fruits. It is advisable that two varieties of pears be planted since cross-pollination will be required to produce fruits. However, the two types must be compatible in with each other and match in bloom time. The soil must be well drained and fertile.

The standard space between trees should be about 1 meter in a row and 3-4 meters between rows. The young trees should be regularly watered and or fertigated to help them establish roots. Fertilizer is applied in the early years of the plant but also later while pruning should be done regularly to help the leaves and branches spread outward and not upward. One should watch out for diseases and pests such as fire blight and mites which can delay the maturity of the tree.

Pears are almost always grafted on a rootstock. It is exceptional that the main rootstocks used are from the family of Cydonia (Quince) Several types are used like Adams, C, Eline etc.

Types of Pear Trees

European pears (*Pyrus calleryana*) ripen in late summer. "Bartlett" pears are the most common pears found in supermarkets in Northern America, but in Europe the most important pears is the Conference followed by the Abate Fetel. Other types of European pears include "Beurre Bosc," Xenia, "Anjou," and "Comice" " But every country has also its own local varieties

The fruit should be harvested green and stored at temperatures between -0,5 and + 0,5 degree C for a few weeks or month, then brought to room temperature to develop best flavor. Some pear varieties can be stored for up to 8 month (Conference). Pears that ripen on the tree have a gritty texture.

Asian pears (*Pyrus pyrifolia*) have a rounder shape than European varieties and require only about 400 chilling hours to European pear's 600 hours. Asian pears taste best when left on the tree to ripen, generally from late summer to early autumn. They can be used to cross-pollinate European pear trees. Varieties include "Chojuro," "Niiataka," "Shinko" and "Tsu Li."



Climate

Storex Controlled Atmosphere/Beneden Havendijk 89/3295 XB's Gravendeel, the Netherlands/www.storex.nl/<tel:+31786733648>/ info@storex.nl

In general, the pear tree thrives in cold and wet climate, where there is winter cold along with a cool summer. It is estimated that the popular pear varieties need about 400-800 hours of cold (exposure to temperatures below 45 °F or 7 °C) in order to have a regular development and fruition.

Preharvest conditions and Harvest

In order to obtain the highest quality fruit, pears must be harvested at the proper stage of maturity. To determine the proper stage of maturity is depended to the market strategy. Pears intended for a long storage period must be harvested early in the picking window but must have enough potential for a good taste development after storage. Once harvested, proper storage is necessary to maximize storage life.

European Pears

Most pears grown in North- and South America and Europe are of European origin. European pears should not be allowed to ripen on the tree. If the fruit are left on the tree to ripen, stone cells develop in the fruit, giving the pears a gritty texture. Tree-ripened fruit are also poorly flavored because they become a mealy structure after harvest and shelflife. Harvest European pears when the color of the fruit changes from a deep green to yellow green. Also, the small spots (lenticels) on the fruit surface change from white to brown. The fruit will still be firm, not soft, at harvest.

For immediate consumption, ripen European pears at room temperature. The ripening process should take seven to ten days. To speed up ripening, place the pears in a tightly sealed paper bag. The fruit give off ethylene gas, which accumulates in the bag and promotes ripening.

For long-term storage, refrigerate unripened pears at a temperature of -0.8-+0,5 degree C. European pears may be stored for one to eight months depended to the variety and storage potential. Remove stored fruit about one week prior to use.



Asian Pears

Asian pears also called Japanese or Chinese pears (sometimes referred to as apple pears because of their round shape and crisp, firm texture) can be successfully grown in different parts of the world. Most common of course in Asia but can also be grown in more warmer climate areas in America.. Popular cultivars include 'Chojuro,' 'Hosui,' and 'Shinseiki.'

Asian pears, unlike European pears, should be allowed to ripen on the tree. Color and taste are the best indicators of maturity. The skin color of most Asian pears changes from green to yellow when ripe. When the color change occurs, pick and sample a pear. Ripe fruit should be crisp, crunchy, and sweet. Harvest Asian pears when the fruit have the appropriate color and taste.

Asian pears can stored for one to three months at a temperature of 32 to 35 degrees Fahrenheit or 0 to +1 degree C.. However, Asian pears sometimes develop a strong, winy taste if stored for long periods.



Harvesting time

One of summer's and autumn's finest fruits is the pear. Pear tree harvest times will vary according to the variety and also from year to year. The early varieties are ready up to a month sooner than late-blooming types. Either way, it is best to pick them firm rather than waiting for them to ripen on the tree. When are pears ripe to eat? They are ready after some counter time unless you like soft, mealy fruit.

Pears don't ripen best on the tree. They ripen from the inside out and develop soft interiors with a mushy, grainy texture.



The optimum time for picking pear fruit will vary dependent on the climate zone zone.

Determining the optimal harvesting time is possible with different methods like the days after full bloom, measurement of brix, firmness, starch breakdown, size and external color. For most commercial varieties is a picking window (for instance 14 days) determined, which can vary from year to year. Fruits intended for a long storage period will be picked in the beginning of the window, at the end of the window the pears are picked for a shorter storage.

More and more pears are picked with gloves to overcome damage. To pick the pear take it in your hand with the finger on the breakpoint at the branch. Sometimes during harvest pears will be sprayed with a natural chemical to prevent early drop from the tree.

The Bartlett Pear



The yellow Bartlett pear (*Pyrus communis* 'Bartlett') is the most popular pear and the first to show up in the grocery store or farmers market. Harvested between August and February, it features the traditional pear shape. Soft and juicy when ripe, they usually arrive at the store while green.

Anjou Pears



The one pear that lasts for months, the Anjou (*Pyrus communis* 'Anjou'), is a late-season bloomer and stores for up to six months without becoming overripe. Shaped more like an egg than a pear, the Anjou's skin is bright green.

Available almost year-round, the Anjou's sweetness hints of citrus. Chefs prefer the Anjou for its versatility and keep them in the larder as they ripen. Tuck them away for about five days, and the Anjou will be ready to eat

Conference Pear



The Conference pear is the most important pear in Europe and will be harvested mainly in September. It is a long shaped green pear with a typical bronze skin with is very variable from pear to pear. Pears can be stored for up to 8 Month in controlled atmosphere. When not well treated in CA combined with late harvest pears are very sensitive for internal browning and cavities. If not treated with 1-MCP the shelflife is short. The taste of the pear is sweet and when soft the it is a melting mouth feeling. When treated with 1-MCP the shelflife could be more than 2 weeks.

Abate Fetel



This pear looks like the Conference pear. It is also a long shaped pear mainly grown in Italy in the region of the Po river. When ripe this pear has also a melting taste. In storage the pear is sensitive for internal browning and scald (skin browning) But nevertheless the pear can be stored for 5-6 Month.

Harvest Maturity

Worldwide the most applied and accepted harvest maturity indicators and standards for the different varieties are: **Soluble solids:** Are not usually used but should be at least 13% for marketability and could be measured with a brix meter

- **Days from full bloom:** Will give an idea of when the pears will be ready for harvest. It is different for every pear variety and region/country. For Conference in North Western Europe it is about 140 days.
- **Iodine-starch test:** Is where the flesh of halved pears is dipped in an iodine solution and the percent of area blue-black is estimated. 60% or less is the accepted amount of the blue-black color for the mature fruit.
- **Flesh firmness:** Determined with a pressure tester, should be 23 pounds, but can be less of the soluble solids are less than 13%.

Measuring pear firmness by using a penetrometer.



- **Ground color:** Changes are from a green to yellowish green.
- **Ease of separation from the branch:** The fruit should come off the spur easily without tearing or breaking the fruiting spur.

Harvesting methods

During harvest, have pickers wear gloves or cut sharp fingernails, which can lead to creating punctures and other entry points for decay fungi. Stem punctures are very common during harvest, so have pickers place pears into the picking basket or bag carefully. Most decay enters pears through punctures or small cuts. But also is common that picked pears directly be laid in in the bin.

Anything you can do to reduce skin breaks in pears will reduce storage rots. Ensure picking bags or baskets are free of any edges that can cut pear skin. The later the pear is harvested, the softer it is and the more prone to punctures and cuts.



Stem puncture causing storage rot.

Scuffing is caused when pears are rubbed or pressed against a rough surface. The damage appears as dark brown or black marks on the skin and increases as the pear gets softer.

To reduce scuffing, use bin liners stapled to the outside of the bin. If liners are stapled to the inside, exposed staples are left when the liner is removed, leaving a source of punctures for the next time the bin is filled. Ensure bins are clean, dry and free of dirt and gravel that could cut or puncture pears.

It is also important that tow-motor drivers keep soil and gravel out of bins and off bin rails. This debris can cut pear skin and also end up in the packing house and storage area where it can contaminate pears.



Scuffing (friction marking) in Bartlett.

Pears are sensitive to bruising during harvest and handling. Physical or mechanical damage, such as scuffing, impact and compression bruising, does not always show up right away but can develop later in storage. It is necessary not to overfill picking baskets and bins, and take care when pouring the pears into the bins. Remind pickers not to press against the bin with their bags when emptying out the pears.

Packing

It is important to minimize vibration during transport from the field to the packing house. Grade orchard laneways, minimize the number of moves for full bins and use air ride suspension systems whenever possible to avoid bruising. Do not leave baskets and bins in direct sunlight, and cool pears as soon as possible for long storage life. Any unnecessary delays in cooling pears have a huge effect on their quality later during storage, normally pears must be the same day in the cooling



Grading pears in the packing house is another area where scuffing and bruising often occur. Pears moving on conveyer belts often come in contact with unprotected edges, machinery parts and other pears, which can cause damage. Protect pears during the packing process by reducing the number of drops, and cushion the area where the pear lands. A drop of 7.6 cm (3 in.) or more onto a hard flat surface damages pear. It is best to use padded ramps, drapes and shallow transitions between belts. It is a well-accepted measure that a few days before grading the temperature in in the cooling room is increased to about 5 degree C.



Pears can either be packed a few days after cold storage, when field heat has been removed from the pears in the bin, or stored until they are ready for market, then graded and shipped to their destination.

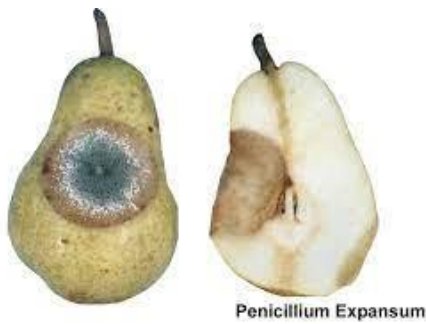
Post-harvest and storage

- Once harvested, pears begin to undergo the ripening process to develop full flavor. It typically only takes a few days to a couple of weeks at room temperature to ripen most cultivars. Firm green pears begin to soften as starch changes to sugar. The skin color also begins to change from green to yellow.
- Cooling the pears prior to storage is one of the most important steps to ensure good fruit quality. The most common method of storing pears is by traditional room cooling and controlled atmosphere. The crop is taken from the field to the cold storage mostly in bins
- Depending on temperatures during harvest, it can often take 48-72 hours to bring the temperature down to approximately 1°C. Controlled atmosphere (CA) storages are used for long-term pear storage. However, CA storage can extend storage life, using atmospheres ranging in 1%-3% oxygen and 0%-2% carbon dioxide, depending on pear cultivar. For most of the varieties it is necessary to pick the fruit early in the picking window when stored in CA. Later picked pears are very sensitive to internal browning in CA. Specifically for Conference pears a delay period of 4 weeks before CA is applied to prevent internal browning and cavities.
- Forced-air cooling is the most common method of rapid cooling for pears, especially in areas of large production. This can cool pears five to eight times faster than traditional room cooling. Hydro-cooling is another effective and rapid method of cooling, but it may increase postharvest decay by spreading pathogens.



Storage rots

1. Blue mould (caused by *Penicillium expansum*).



2. Grey mould (caused by *Botrytis cinerea*).



- 3.

Fish eye rot, (Cadophora, Phialophora)



This fungi is most common in western Europe, especially the Conference pear is sensitive. After about 6-7 month the first symptoms will be found on the pears as little spots. If they are found the disease will be spread very fast on the pears through the cel. Especially after cell opening and the distribution phase there will be also a fast development. Most common control method is a pre harvest dip with specific chemicals.

These are spread easily through the air in storages, so it is important to maintain a preharvest orchard spray program and monitor fruit regularly during storage. Handle pears carefully during and after harvest to minimize stem punctures, skin breaks and bruises, which act as infection sites for fungi. During storage and transportation, move the bins with minimal jolts and drops. Cool and refrigerate the pears as quickly as possible. Each storage room must have adequate refrigeration capacity. Using modern refrigeration facilities and controlled atmospheres reduces storage rot.

Sanitation in the handling and grading area is important. Remove rotted pears from the premises and property. Postharvest treatment with fungicides can reduce disease incidence.

Senescence scald

Senescent scald and storage scald are the main external physiological disorders that develop on pears in storage. Senescent scald develops when pears lose their ability to ripen, after extended storage durations. The pears turn yellow and eventually develop dark brown skin.

The browning can start during storage or right after the pears are put into room temperature. Reducing the storage period and using all best management practices can reduce the chances of senescent scald. It can also be reduced if pears are stored in controlled atmosphere storage.



Senescent scald in Bartlett.

Storage scald (also known as superficial scald) develops during storage, but signs are not visible until pears are moved to warmer temperatures. This is strictly a surface disorder, which causes bronzing of the skin. Storage scald can be reduced if pears are stored in low-oxygen storage.



Storage (superficial) scald in Sundown.



A type of scald on Conference.

Internal breakdown

Core breakdown is a serious internal disorder, different pear varieties are sensitive to this disorder like Bartlett, Conference, Abate fetel etc. It can only be detected by cutting into the pear. The pear becomes unmarketable, as the flesh in and around the core turns brown and soft. Late-harvested pears are usually more susceptible. Pears that tend to soften quickly, like Bartlett, are generally prone to this disorder. For some varieties is time Maintaining proper temperatures from harvest right through to retail marketing is important for controlling this disorder as a result of ripening For other varieties like Conference and Abate Fetel right storage conditions in CA in combination with a delay period for establishment of oxygen and CO₂ necessary to avoid this problem. Specifically this type of disorder must be considered as a physiological disorder.



Core breakdown in Bartlett.



Internal browning and cavities in Conference pear

Ethylene

A new technology was recently commercialized for delaying the ripening of apples and pears during storage. SmartFresh™ (1-methylcyclopropene, 1-MCP) inhibits the action of ethylene, the natural ripening hormone of pears. It has been shown to

inhibit ethylene production, retard respiration rate, delay or prevent softening, and substantially reduce storage disorders in various pear cultivars.

Conclusions from a review on the ripening of European pears indicate that there is still no clear understanding of the best combination of harvest maturity, SmartFresh concentration, application conditions (temperature and time) and storage time after SmartFresh treatment to adequately control softening and the development of physiological disorders, while simultaneously allowing the pear to ripen to good quality for marketing. 24 hours treatment with 300 ppb 1-MCP applied 3-10 days after harvest provides the best balance of reduced disorder development during storage and the ability of different pear varieties pears to soften adequately thereafter. Sometimes in other growing areas, there continues to be a risk of excessive inhibition of ripening when using MCP on European pears. Applied in CA in some cases a delay period for the pull down of oxygen is 9 weeks for Conference pears.

Harvest all pears destined to be stored for any duration at the proper maturity, and handle them with care during harvest. Cool pears as quickly as possible and store them at the proper temperature (-1°C to 0°C) with high humidity (90%-95%). With -MCP most pear cultivars will remain firmer during storage and for longer periods of time after being removed from storage. In addition, 1-MCP substantially reduces storage disorders.