UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF PREVENTION, PESTICIDES AND TOXIC SUBSTANCES

January 21, 2009

MEMORANDUM

Subject: Crop Grouping – Part VII: Analysis of the USDA IR-4 Petition to Amend the Crop Group Regulation 40 CFR § 180.41 (c) (11) and Commodity Definitions [40 CFR 180.1 (g)] Related to the Crop Group 11 Pome Fruit.

PC Code: NA	**DP Barcode:** NA
Decision No.: NA	**Registration No.:** NA
Petition No.: NA	**Regulatory Action:** Crop Grouping Regulation
Risk Assessment Type: None	**Case No.:** NA
TXR No.: NA	**CAS No.: NA**
MRID No.: 468579-01	**40 CFR:** 180.41 (c) (11) and 180.1 (g)

FROM: Bernard A. Schneider, Ph.D., Senior Plant Physiologist
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THROUGH: William Donovan, Ph.D. and Michael Doherty, Ph.D., Chairpersons
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TO: Barbara Madden, Minor Use Officer
Risk Integration, Minor Use, and Emergency Response Branch (RIMUERB)
Registration Division (7505P)

cc: IR-4 Project, Bill Barney, Jerry Baron, Dan Kunkel, Van Starner

REQUEST:

Dr Hong Chen, Crop Grouping Project Coordinator, USDA Interregional Research Project No. 4 (IR-4), State Agricultural Experiment Station, Rutgers University has submitted a petition (May 11, 2006) on behalf of the IR-4 Project, and the Pome Fruits Workgroup of the International Crop Grouping Consulting Committee (ICGCC) to amend the Crop Group Regulation 40 CFR § 180.41 (c) (11) Crop Group 11, Pome Fruits Group, and propose Commodity Definitions 40 CFR 180.1 (g) for crabapple.

The above mentioned Pome fruit crop group petition requested the following three amendments:

1. Amend the existing crop group in 40 CFR 180.41 (c) (11) that consists of the following seven commodity entries:

1. Apple, *Malus domestica* Borkh.
2. Crabapple, *Malus* spp.
3. Loquat, *Eriobotrya japonica* (Thunb.) Lindl.
4. Mayhaw, *Crataegus aestivalis*, *C. opaca*, and *C. rufula*.
5. Pear, *Pyrus communis* L.
6. Pear, oriental, *Pyrus pyrifolia* L.
7. Quince, *Cydonia oblonga* Mill.

To an expanded crop group that consists of the following 10 commodity entries:

1. Apple, *Malus domestica* Borkh. (Rosaceae)
2. Crabapples, *Malus* spp. (Rosaceae) (Chinese apple, Chinese crabapple, Chinese flowering Apple, Crabapple, Cutleaf crabapple, Florentine crabapple, Hall crabapple, Iowa crabapple, Japanese crabapple, Kai do crabapple, Manchurian crabapple, Paradise apple, Sargent's crabapple, Siberian crabapple, Soulard crabapple, Southern crabapple, Sweet crabapple, Tea crabapple, Toringa crabapple, Western Crabapple, Yunnan crabapple, and varieties and/or hybrids of these)
3. Loquat, *Eriobotrya japonica* (Thunb.) Lindl. (Rosaceae)
4. Mayhaw, *Crataegus aestivalis*, *C. opaca*, and *C. rufula* (Rosaceae)
5. Medlar, *Mespilus germanica* L. (Rosaceae)
6. Pear, *Pyrus communis* L. (Rosaceae)
7. Pear, Oriental, *Pyrus communis* L. (Rosaceae)
8. Quince, *Cydonia oblonga* Mill. (Rosaceae)
9. Quince, Chinese, *Chaenomeles speciosa* (Sweet) Nakai (Rosaceae)
10. Tejocote, *Crataegus pubescens* (Rosaceae)

And all varieties and/or hybrids of these

2. Retain the current commodities, Apple, and Pear, as representative commodities also for the expanded group.

3. Expand the commodity term for crabapples to include: Chinese apple, Chinese crabapple, Chinese flowering Apple, Crabapple, Cutleaf crabapple, Florentine crabapple, Hall crabapple, Iowa crabapple, Japanese crabapple, Kai do crabapple, Manchurian

crabapple, Paradise apple, Sargent's crabapple, Siberian crabapple, Soulard crabapple, Southern crabapple, Sweet crabapple, Tea crabapple, Toringa crabapple, Western Crabapple, Yunnan crabapple, and varieties and/or hybrids of these).

BACKGROUND:

All seven commodities in the current Crop Group 11, Pome fruits Group in 40 CFR 180.41 are members of the *Rosaceae* or Rose botanical family. Apple and pear were selected as representative commodities for this group. The crop group regulation for Pome Fruits Group has facilitated establishment of 47 group tolerances on pome fruits.

It is interesting to view the production data for some pome fruits from FAO agriculture statistics. The world total acreage for apples, pears, and quinces decreased from 7,817,276 hectare in 1995 to 6,681,092 hectare in 2005, however the total production of these fruits has increased from 63,428,802 metric tons in 1995 to 834,719,870 metric tons in 2005 (FAO 2005; Table 6). Some "minor" pome fruits commodities have become more popular in some countries and areas today than they were 10 years ago, such as crabapples, mayhaw, and the "orphan" crops medlar and tejocote. Some of these fruits don't have large commercial production, and thus have little chance to be added to pest control products labels unless they are placed in the pome fruit group. Some of these "minor" pome fruits have great potential to be grown on a larger scale in some areas in the future due to their unique nutritional and medicinal values, such as mayhaw. Mayhaw contains the highest red pigment and pectin among fruits, which give it a natural food color and texture for jelly and its vitamin and mineral components are also among the highest of the fruits, and the vitamin C content is next to dates and kiwifruit and is 18 times higher than apple. In a news release in 2005, it was reported that mayhaws were growing in popularity in Louisiana, where production was almost doubled in 2004. USDA CSREES Newsroom reported last year that the farm gate value of Louisiana mayhaw production increased from less than $200 in 1992 to $123,678 in 2004, and the market value for orchard mayhaw products last year was more than $500,000. Currently mayhaw has not been included in either Codex or EU pome fruits group, but there is relatively larger commercial mayhaw production in some countries such as China. It will benefit growers and consumers if this commodity is also added to both the Codex and the EU groups. The "orphan" crops medlar and tejocote were not included in the existing U.S. EPA pome fruits group, but they are listed in both Codex and EU pome fruits groups. Adding these two commodities in the EPA pome fruits group will help our effort in harmonizing with the Codex and EU crop classification systems. Being excluded from the crop groups, tolerances requested for these commodities would have to be established based on separate residue studies. Without a doubt the inclusion of these commodities in crop groups will benefit growers, consumers, save time and tax payer's money on residue studies, save government agencies time in review residue data, as well as facilitating the establishment of import tolerances.

This petition proposes "Pome fruits Group 11" with 10 commodity entries in the genera *Malus*, *Eriobotrya*, *Chaenomeles, Crataegus*, *Mespilus*, *Pseudocydonia, Pyrus* and *Cydonia*, which are all in the *Rosaceae* botanical family. Compared to the many other crop groups, commodities in this group are all closely related since they are all in the same family and especially share similar morphological and cultural characteristics. The 10 commodities in the proposed crop group are temperate season perennial trees grown for edible fruits. The fact that these fruits are in the same botanical family with similar biological and cultural aspects suggests they should also encounter similar pest problems and hence have similar needs for pest control products in similar use patterns. Commodities and their varieties and/or hybrids proposed in this group will include all the commodities in the Codex Classification of Pome Fruits Group and EU Crop List of Pome Fruits Group.

The Crop Group 11 proposal was generated at the USDA/IR-4 Crop Grouping Symposium in Washington, DC, October 2002 by the Temperate Tree and Small Fruit Workgroup Chaired by Van Starner of USDA, IR-4 and Co-Chaired by Craig Hunter, Canadian Horticultural Center, Rick Melnicoe, University of California Department of Environmental Toxicology, Dr. Richard Loranger and Chris Olinger, EPA, HED and John Wise, Michigan State University. It was further discussed and developed within the pome fruits Workgroup of the ICGCC. This workgroup consists of over 200 crop or regulatory experts from the US, and NAFTA, EU, Asia, Middle East, and Latin America Regions representing over 40 countries. The Workgroup discussed and validated each of the proposed commodities and representative commodities. Representative commodities in the existing EPA Pome Fruits Group, apple and pear, have been recommended by the Workgroup to be representative commodities for the proposed amended group. Another important aspect is the harmonization with the Codex crop classification. The Codex Classification of foods and animal feeds for Pome Fruit Group is also undergoing revision. The IR-4/EPA Crop Grouping Working Group and the International Crop Grouping Consulting Committee (ICGCC) are making every effort to collaborate with the revision of the Codex crop classification. The expanded Pome Fruit Group and the representative commodities proposed in this petition would facilitate the harmonization of the U.S. and the Codex crop classification systems.

HED RECOMMENDATIONS:

Each of the proposals and recommendations will be discussed below, followed by a series of other recommendations on terminology, database development, and harmonization with Codex. The EPA would like to commend the valuable and high quality input of the ICGCC, all its members, and the Committee Chairperson Dr Hong Chen and Bill Barney, USDA IR-4, as well as Dr. Yuen-Shaung Ng, Biologist, HED, Jessie Cordova, HED Information Technical Specialist, Susan Stanton, Roger Chesser and Laura Nollen, Biologists, RD, EPA for their input and development of various databases in this report and Dr. Paul Schwartz, USDA, Office of Minor Use Pesticides for his advice and peer review.

IR-4 Proposal 1:

1. "Amend the existing crop group in 40 CFR 180.41 (c) (11) that consists of the following seven commodity entries:

1. Apple, *Malus domestica* Borkh.
2. Crabapple, *Malus* spp.
3. Loquat, *Eriobotrya japonica* (Thunb.) Lindl.
4. Mayhaw, *Crataegus* spp.
5. Pear, *Pyrus communis* L.
6. Pear, oriental, *Pyrus communis* L.
7. Quince, *Cydonia oblonga* Mill.

To an expanded crop group that consists of the following 10 commodity entries:

1. Apple, *Malus domestica* Borkh. (*Rosaceae*)
2. Crabapple, *Malus* spp. (*Rosaceae*) (Chinese apple, Chinese crabapple, Chinese flowering Apple, Crabapple, Cutleaf crabapple, Florentine crabapple, Hall crabapple, Iowa crabapple, Japanese crabapple, Kai do crabapple, Manchurian crabapple, Paradise apple, Sargent's crabapple, Siberian crabapple, Soulard crabapple, Southern crabapple, Sweet crabapple, Tea crabapple, Toringa crabapple, Western Crabapple, Yunnan crabapple, and varieties and/or hybrids of these)
3. Loquat, *Eriobotrya japonica* (Thunb.) Lindl. (*Rosaceae*)
4. Mayhaw, *Crataegus* spp. (*Rosaceae*)
5. Medlar, *Mespilus germanica* L. (*Rosaceae*)
6. Pear, *Pyrus communis* L. (*Rosaceae*)
7. Pear, Oriental, *Pyrus communis* L. (*Rosaceae*)
8. Quince, *Cydonia oblonga* Mill. (*Rosaceae*)
9. Quince, Chinese, *Chaenomeles speciosa* (Sweet) Nakai (*Rosaceae*)
10. Tejocote, *Crataegus pubescens* (*Rosaceae)*

And all varieties and/or hybrids of these."

HED Recommendation for Proposal 1:

Based on similarities and characteristics of the *Roseaceae* or Rose family which includes all the proposed members to the Pome Fruit Crop Group 11, as well as a comparison of pome fruits, cultural practices, edible food and animal feed portions, residue levels, geographical location, pest problems, established tolerances, and for international harmonization purposes, I recommend that ChemSAC concur to amend the Pome Fruit Crop Group 11 from seven commodities to twelve commodities.

While USDA IR-4 submitted a amended crop group with three new commodities (Medlar, Chinese quince, and Tejocote), further research and International comments provided supporting data to add an additional two commodities (Azarole and Japanese quince) to the group. In addition to Chinese quince, we recommend to add Japanese quince to the list of commodities, since they are distinct crops in that growing regions and fruit size are different. There were no crop subgroups proposed by IR-4 or recommended for this crop group.

The scientific names of the twelve commodities were also updated and are listed below.

"HED Corrected Proposed Pome Fruit Crop Group 11 - 09".

Commodities
Apple, *Malus domestica* Borkh.
Azarole, *Crataegus azarolus* L.
Crabapple, *Malus sylvestris* (L.) Mill., *Malus prunifolia* (Willd.) Borkh.
Loquat, *Eriobotrya japonica* (Thunb.) Lindl.
Mayhaw, *Crataegus aestivalis* (Walter) Torr. & Gray, *C. opaca* Hook. & Arn., and *C. rufula* Sarg.
Medlar, *Mespilus germanica* L.
Pear, *Pyrus communis* L
Pear, Asian, *Pyrus pyrifolia* (Burm. f.) Nakai var. *culta* (Makino) Nakai
Quince, *Cydonia oblonga* Mill.
Quince, Chinese, *Chaenomeles speciosa* (Sweet) Naka, *Pseudocydonia sinensis* (Thouin) C.K. Schneid.
Quince, Japanese, *Chaenomeles japonica* (Thunb.) Lindl. Ex Spach
Tejocote, *Crataegus mexicana* DC.

Cultivars, varieties and/or hybrids of those above commodities

Additional notes:

- HED also recommends that crabapple not include all the others common names associated with the crop as was proposed. These terms will be included in the Food and Feed Commodity Vocabulary as lookup terms and crabapple will be the preferred commodity name.
- HED also recommends changing the preferred commodity name for Oriental pear to Asian pear, since Asian pear has become the prefer commodity name in the marketplace trade and in grocery stores.
- HED also recommends that in the crop group table the term "varieties and/or hybrids of these" should be changed to, "varieties, cultivars and hybrids, of these commodities" to avoid all confusion with terminology regarding whether they are varieties, cultivars, or hybrids of the any pome fruit commodities.

IR-4 Proposal 2:

2. "Retain the current commodities, Apple, and Pear, as representative commodities also for the proposed expanded group."

HED Recommendation for Proposal 2:

I recommend ChemSAC concur to retain apple and pear as the representative commodities for the amended Pome Fruit Crop Group 11. These two representative commodities account for > 99 % of the harvested acres for the members of the amended Pome Fruit Group. The representative commodities are based on similarities in fruit and cultural practices and geographical locations, as well as their high production (both acres and yield) and consumption. A comparison of established tolerances on pome fruit commodities also supports that residue levels will be similar between members of the crop group.

IR-4 Proposal 3:

"A commodity definition for Crabapples will need to be established in 40 CFR 180.1 (g) to list all the types of crabapples such as Crabapples, Malus spp. (*Rosaceae*) (Chinese apple, Chinese crabapple, Chinese flowering Apple, Crabapple, Cutleaf crabapple, Florentine crab apple, Hall crabapple, Iowa crabapple, Japanese crabapple, Kai do crabapple, Manchurian crabapple, Paradise apple, Sargent's crabapple, Siberian crabapple, Soulard crabapple, Southern crabapple, Sweet crabapple, Tea crabapple, Toringa crabapple, Western Crabapple, Yunnan crabapple, and varieties and/or hybrids of these)."

HED Recommendation for Proposal 3 Commodity Definition for Crabapple:

I recommend **rejecting** the Crabapple commodity definition under 40 CFR Part 180.1(h) because these crabapples will be listed in the EPA Food and Feed Commodity Vocabulary (http://www.epa.gov/pesticides/foodfeed) as lookup terms and the preferred term for all of them will be crabapple.

Additional HED Recommendations/Conclusions:

HED Recommendation 4:

Another important aspect of crop grouping is the harmonization effort with the Codex Classification of Foods and Animal Feeds. The current EPA crop group for Pome fruit group 11 is similar to the corresponding Codex Pome fruits (Crop Group 002). The Codex Group 002, Pome Fruits, consists of eleven commodities including six of the seven commodities in the current EPA crop group 8. The only exceptions are mayhaw which is in the U.S. crop grouping system and medlar which is in the Codex system. The U.S. Crop group is also proposing to add three new commodities: azarole, Chinese quince, and tejocote that are not yet in the Codex classification system. EPA will change the name of the commodity Oriental pear to Asian pear based on the international usage of Asian pear as a trade name for this commodity. The eleven Codex commodities really consist of seven distinct commodities with the rest being multiple entries, or varieties of cultivar of other commodities listed. The scientific name for Oriental pear in the Codex system is incorrect *Pyrus pyritolia* should be *Pyrus pyrifolia* (Burm. f.) Nakai var. *culta* (Makino) Nakai and the scientific name for pear should be *Pyrus communis* L. not *Pyrus pyrifolia.* Note that the current Codex crop group does not have representative commodities. A revision of the Codex Classification is underway with consideration to include adding new commodities, creating subgroups, and selecting representative commodities.

HED Recommendation 5:

Guidance for HED SOP 99.6 - "Classification of Food Forms with Respect to Level of Blending" issued August 20, 1999, and HED SOP 2000.1 – "Guidance for Translation of Field Trial Data from Representative Commodities in the Crop Group Regulation to Other Commodities in Each Crop Group/Subgroup" issued September 12, 2000 can be updated to reflect the amendment to the Pome fruit group 11.

HED Recommendation 6:

Guidance on expressing tolerance terminology for the Pome fruit crop group 11 is discussed under the "Tolerance expression guidance section of this analysis.

HED Recommendation 7:

The Health Effects Division Dry Matter and Seeding Rate Database prepared by Dr's. Yuen-Shaung NG and B. A. Schneider, was updated on September, 2008 in Table 44 for the Pome Fruit Group.

HED Recommendation 8:

New lookup and preferred EPA terms for the members of the Pome Fruit Crop Group are listed in the EPA Food and Feed Commodity Vocabulary section of this report and these terms should be added to the updated EPA Food and Feed Commodity Vocabulary website (http://www.epa.gov/pesticides/foodfeed).

ANALYSIS OF THE USDA IR-4 PROPOSAL TO ESTABLISH AN AMENDED POME FUIT GROUP 10

BOTANICAL CHARACTERISTICS OF PROPOSED COMMODITIES:

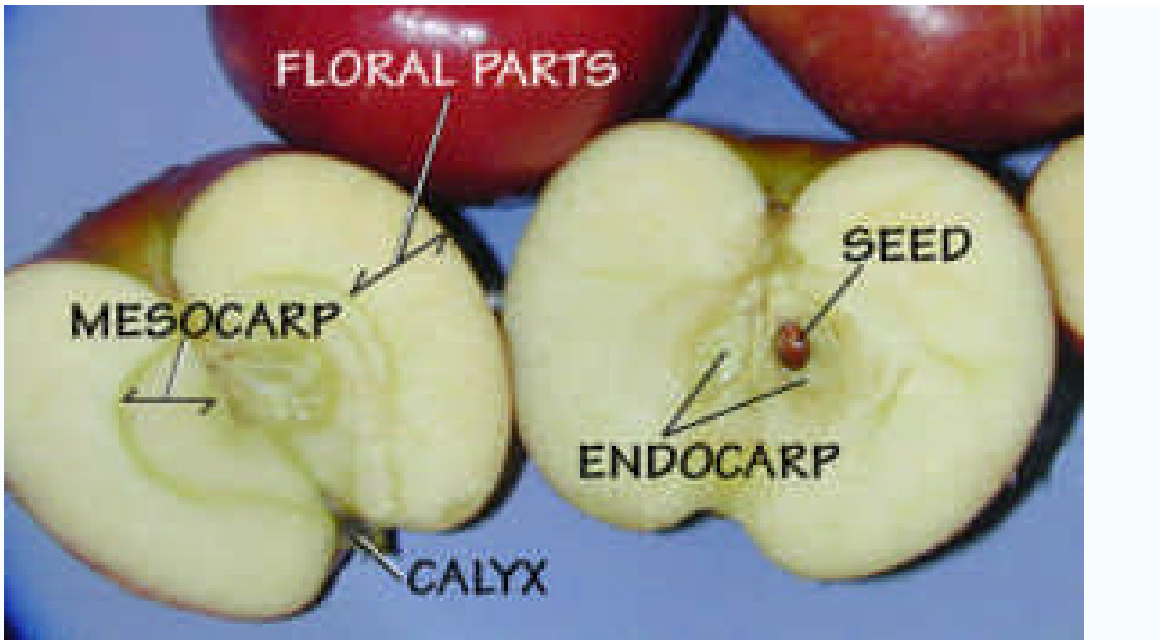
Pome fruits are all members of the family *Rosaceae*. The family *Rosaceae* or Rose family has four subfamilies of which the pome fruits are contained in the *Maloideae* subfamily. This petition proposes "Pome fruits Group 11" with 10 commodity entries in the genera *Malus*, *Chaenomeles, Crataegus, Cydonia, Eriobotrya*, *Mespilus*, and *Pyrus*, all in the same *Rosaceae* botanical family. Compared to the many other crop groups, commodities in this group are all closely related since they are all in the same family/subfamily and share similar morphological, cultural characteristics, and pest problems. There are over 100 genera and over three thousand species in the *Rosaceae* family. The greatest diversity of members of the *Rosaceae* is in Europe, Asia, or North America. The family includes some of the most well-known garden trees and shrubs, including the rose, cotoneaster, pyracantha, geums, kerria, and British native species such as hawthorn and rowan. The family also includes many fruits of temperate regions, including apple, pear, cherry, plum, peach, raspberry and strawberry.

While there are many different types of fruits in the rose family, ranging from single-seeded, soft, fleshy, fruits known as drupes to harder, fleshy pseudocarps such as a pome or hip. In the genera *Malus* (apples and crabapples), *Chaenomeles*, and *Rosa,* the true fruit is engulfed in a fleshy structure called the hypanthium, which is composed of the swollen stem or base of petals and sepals. In the mature pseudocarp (pome), the true fruit is centrally located and contains five distinct carpels which may contain one or more seeds each. The fleshy tissue which surrounds the fruit is the hypanthium. A pome is an accessory fruit composed of five or more carpels in which the exocarp forms an inconspicuous layer. The mesocarp is usually fleshy, and the endocarp forms a leathery case around the seed. Outside of the endocarp is the most edible part of this fruit, derived from the floral tube (torus) and other parts, which corresponds to what is commonly called the core. The shriveled remains of the sepals, style and stamens can be seen at the end of a pome opposite the stem, demonstrating that the ovary is inferior in these flowers. This type of fruit is called a pome (See Figure 1). In botany, a pome (after the French name for an apple: pomme) is a type of fruit produced by flowering plants in the Subfamily *Maloideae* of the Family *Rosaceae*. A special fruit type is given to apple and related fruits - the pome. The subfamily *Maloideae* includes apple, pear, Chinese quince,

quince, loquat, medlar, mayhaw, and tejocote. The bulk of the fleshy edible portion derives from the hypanthium or floral cup, not the ovary as most fruits and is called an accessory fruit since it derives from other floral parts. Seeds are relatively small and black, and mildly poisonous.

The best know example of a pome fruit is the apple. Other examples of plants that produce fruit classified as a pome are pear, loquat, azarole, mayhaw, quince, cotoneaster, hawthorn, Pyracantha, rowan, and whitebeam.

Figure 1. Cross Section of a Pome Fruit (Apple is a Classic Example of a Pome Fruit).



The current Crop Group 10, Pome fruit group, has been successful in establishing tolerances for the seven members of this group. There are three pome fruit "orphan crops" grown commercially or in small scales, and sold and consumed in the U.S. or other regions or countries. Many of these crops are of economic importance or have a great potential to be grown in larger scale in the future due to their nutritional value, or the increased market demand driven by both the growing ethnic populations and greater awareness of these crops by the non-ethnic population as a whole. Being excluded from the crop groups, tolerances requested for these commodities would have to be established based on separate residue studies. Without a doubt the inclusion of these commodities in crop groups will benefit growers, consumers, save time and tax payer's money on residue studies, save government agencies time in review residue data.

ORIGIN, HISTORY OF CULTIVATION

The center of diversity of the genus *Malus* is the eastern Turkey, southwestern Russia region of Asia Minor (Republic of Kazakhstan). Apples were probably improved through selection over a period of thousands of years by early farmers. Alexander the Great is credited with finding dwarfed apples in Asia Minor in 300 BC; and he brought back to Greece may well have been the progenitors of dwarfing rootstocks. Apples were brought to North America with colonists in the 1600's, and the first apple orchard on this continent was said to be near Boston in 1625. From New England origins, apples moved west with pioneers, John Chapman (alias Johnny Appleseed) and various missionaries during the 1700's and 1800's. In the 1900s, irrigation projects in Washington State began and allowed the development of the pome fruit industry of which the apple is the leading species. Apples are grown between latitudes 30° and 50° north and south. Limiting factor in apple production at latitudes lower than 30° is a lack of adequate chilling in the winter. There are over 10,000 apple cultivars worldwide but only a few dozen have international importance (Table 17). The development of more heat tolerant apple cultivars and long growing season varieties like 'Granny Smith' and 'Fuji" and the use of irrigation has extended apple production to areas with a warmer climate. Apples can grow on a wide range of soil types. The optimum soil pH ranges from 6.5 – 7.0. The ten commodities in the proposed crop group are all cool season temperate perennial trees gown for their fruits.

Pears are placed in the Rose family (*Rosaceae*), subfamily *Pomoideae* along with apple and quince. The genus *Pyrus* is composed of about 22 species, found in Asia, Europe, and northern Africa. Two major species are commercially cultivated: European pear: *Pyrus communis* L. This species does not occur in nature, and possibly derives from *P. caucasia* and *P. nivalis* (snow pear). This is the major pear of commerce. The other pear is the Asian pear *P. pyrifolia* (Burm. f.) Nak. [syn. P. serotina L.] and it is also called "Japanese" or "Oriental" pear, or "Nashi". Grown mostly in the Orient, this fruit has been increasing in popularity in the USA over the last 20 years.

Like its relative the apple, the European pear is not found in the wild. Its probable ancestors are native to Eastern Europe and Asia Minor near the Mediterranean, but it is not known when they may have hybridized to yield *P. communis*. The European pear has been selected and improved since prehistoric times, and has been cultivated in Europe since 1000 BC. Pears probably came to the U.S. with the first settlers on the east coast in the 1700's, and spread westward with pioneers. When moved to the Pacific Northwest in the 1800s, European pears were able to escape fire blight, a serious bacterial disease that limited pear cultivation in the east. Today, over 90 % of the pear crop is grown in the Pacific Northwest, such as the Hood River Valley of Oregon and California. There are relatively few cultivars of European or Asian pear grown worldwide. Only about 20 - 25 European and 10 - 20 Asian cultivars represent virtually all the pears of commerce. Almost all European cultivars were chance seedlings or selections originating in Western

Europe, mostly France. 'Bartlett' is the most common pear cultivar in the world, and represents about 75% of US pear production.

Asian pears were domesticated in China about the same time European pears were in Europe, 3000 years ago. *Pyrus pyrifolia* is native to central and southern China, and probably the first to be domesticated since fruit of wild trees is edible. Fruit of the wild *P. ussuriensis* is astringent, small, and course-textured, so that it was probably hybridized with *P. pyrifolia* prior to domestication. Chinese writings dating from 200 - 1000 BC describe pear propagation and culture. All of the Asian cultivars originated in Japan and China. Asian pears moved from China to Japan, Korea, and Taiwan, where they are still cultivated commercially today. Asian pears appear more like apple than European pear, and have hard, crisp flesh like apples when ripe, unlike the soft flesh of the European pears. Also, Asian pears will ripen on trees like apples, but European pears are subject to core breakdown if allowed to ripen fully on-tree.

The common European pears have a pyriform shape while Asian pears have a round fruit shape. As in apple, the fleshy edible portion is derived from hypanthium tissue. There are five central seed cavities, usually bearing two seeds each as in apple. The flesh contains grit cells (termed brachysclereids), which are thick-walled, lignified cells that give the characteristic European pear flesh texture. Pears are thinned to 1 - 2 fruit per spur branch and spaced 6 inches apart.

The members of this crop group have similar uses, and all are consumed fresh or consumed cooked or raw in various recipes including salads, jellies, and juices. They can also be used fresh or in a dehydrated form. Some of these pome fruits also have medicinal properties. The fact that these pome fruits are in the same family with similar biological and cultural aspects suggests they should also encounter similar pest problems and hence have similar needs for pest control products in similar use patterns.

Among the 10 commodities proposed only three are new to this crop group (Chinese quince, Japanese quince, medlar, and tejocote. Azarole and Japanese quince were also found to have similar characteristics to become a member of the Pome fruit group. Apples and pears are the widely grown pome fruits in the world with largest acreages and are the representative commodities for the current pome fruit group.

GROWTH AND DEVELOPMENT OF THE POME FRUIT CROPS

Understanding how the pome fruit crops grow and develop is a key part of developing a pest control strategy for optimum fruit yield and quality and a helpful reference for analysis of residue field trials by EPA scientists. Proper timing of pesticide applications, based on crop growth stage and pest growth cycle can improve a product's efficacy and prevent crop injury and yield losses. Pesticide labels often use crop growth stages and codes to identify when to apply a pesticide, as well as the pome fruit State Extension pest control recommendations and spray schedules are based on these distinct growth stages. For example, the growth stages in Tables 2, 3, and 4 do not show when

spray treatments must be applied but will show when any combination of a pest control treatment when needed can be applied. Rarely, if ever, will a grower need to apply treatments at all of the key growth stages shown for a given fruit. The number, distribution, and content of needed treatments will vary between the major fruit growing regions of the world and within any given region and are dependent on pest pressures which reduce the yield, quality, and marketability of the fruit. In our reviews we often have to consider the number of days from a specific apple growth stage to harvest in order to determine the total number of pesticide applications and to establish a preharvest interval (PHI). Pesticide spray application are timed according to specific growth stages, with early season pesticide applications are timed according to the opening of the leaf and flower buds in the spring (see Table 5, dormant through bloom stages), and later season applications are called full tree cover sprays.

Some of the internationally recognized growth stages for the pome fruits are listed as BBCH Codes (Biologische Bundesanstalt, Bundessortenamt and Chemical industry) and are shown in Table 1. They are based on the principal growth stage such as leaf development and flowering and list a standard BBCH Code for each stage as well as a description of each code. Pome fruit growth stages for apple (Table 2) and pear (Table 3) are also essential for identifying the propose timings to scout pest problems for control of these pests and for applications of pesticides as part of an integrated pest management program (IPM). A comparison of the growth stages for apple and pear such as petal fall stage during growth and flowering will help the reviewer understand similar growth stages for evaluating spray schedules and label direstions (Table 4). Fruit set is a growth stage reached in apple, for example, 5 to 10 days after the end of bloom or when one can readily see which blossoms have at least temporarily set fruit and which ones have not set fruit. In a "normal" year fungicides may be needed to be applied at the growth stages (Table 2) green tip, half inch green, tight cluster, pink, petal fall, and fruit set stages. After the petal fall stage in apple and pear (Tables 2 and 3), the pesticide applications are often called “cover sprays” and up to seven cover sprays may be needed. There are also separate spray schedules for apples intended for processing and for nonbearing fruit trees. Examples of growth stage use in apples is for controlling of apple scab infections is a dominant concern of New York pome fruit growers. The most effective time to use oil spray to control the European red mite and for powdery mildew is at the tight cluster stage. In areas where the plum curculio is troublesome, the treatment applied at the fruit set stage has been called "the curculio spray" and treatments applied at the petal fall and fruit set stages are important in a program to control this pest. Similarly for pears pesticide treatments are used primarily for the control of pear psylla and fire blight. One or two oil sprays applied in the bud swell stage provides good initial control of the psylla and blister mite (Table 3). Fire blight may be contained by good control of its vectors which are psylla, plant bugs, and aphids in the green cluster and petal fall sprays and by use of a bactericide in full bloom stage.

Table 1. Selected Principal Growth Stages for Pome Fruit Group (Apple and Pear). BBCH Identification Codes (Adapted from Meier, 1994).

BBCH Code	Principal Growth Stage	General Description
00	Sprouting/Bud development	Dormancy: leaf buds and the thicker inflorescence buds closed and covered by dark brown scales.
01	Sprouting/Bud development	Beginning of leaf bud swelling: buds visibly swollen, bud scales elongated, with light colored patches
03	Sprouting/Bud development	End of leaf bud swelling: bud scales light colored with some parts densely covered by hairs.
07	Sprouting/Bud development	Beginning of bud break, first green leaf tips just visible.
09	Sprouting/Bud development	Green leaf tips about 5 mm above bud scales.
10	Leaf development	Mouse-ear stage: Green leaf tips 10 mm above the bud scales; first leaves separating.
11	Leaf development	First leaves unfolded (others still unfolding.
15	Leaf development	More leaves unfolded, not yet at full size.
19	Leaf development	First leaves fully expanded.
31	Shoot development	Beginning of shoot growth; axes of developing shoots visible.
32	Shoot development	Shoots about 20% of final length
33	Shoot development	Shoots about 30% of final length
39	Shoot development	Shoots about 90% of final length.
51	Inflorescence emergence	Inflorescence buds swelling: bud scales elongated, with light colored patches.
52	Inflorescence emergence	End of bud swelling: light colored bud scales visible with parts densely covered by hairs
3	Inflorescence emergence	Bud burst: green leaf tips enclosing flowers visible.
54	Inflorescence emergence	Mouse-ear stage: green leaf tips 10 mm above bud scales; first leaves separating.
55	Inflorescence emergence	Flowers visible still closed.
56	Inflorescence emergence	Green bud stage: single flowers separating but still closed.
57	Inflorescence emergence	Pink bud stage: flower petals elongating; sepals slightly open; petals just visible.
59	Inflorescence emergence	Most flowers with petals forming a hollow ball.

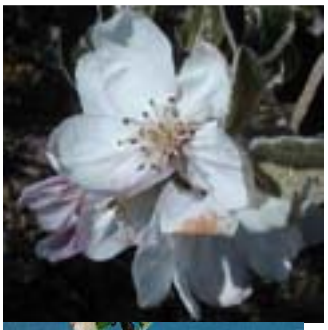
BBCH Code	Principal Growth Stage	General Description
60	Flowering	First flowers open.
61	Flowering	Beginning of flowering: about 10% of flowers open
62	Flowering	About 20% of flowers open
63	Flowering	About 30% of flowers open
64	Flowering	About 40% of flowers open
65	Flowering	Full flowering: at least 50% of flowers open, first petals falling.
67	Flowering	Flowers fading: majority of petals fallen
69	Flowering	End of flowering, all petals fallen.
71	Development of Fruit	Fruit size up to 10 mm; fruit fall after flowering.
72	Development of Fruit	Fruit size up to 20 mm.
73	Development of Fruit	Second fruit fall
74	Development of Fruit	Fruit diameter up to 40 mm; fruit erect. (T-stage: underside of fruit and stalk forming a T).
75	Development of Fruit	Fruit about half final size
76	Development of Fruit	Fruit about 60% final size
77	Development of Fruit	Fruit about 70% final size
79	Development of Fruit	Fruits about 90% of final size.
81	Maturity of fruit	Beginning of ripening: first appearance of cultivar-specific color.
83	Maturity of fruit	Fruit ripe for picking, has not developed variety specific color.
85	Maturity of fruit	Advanced ripening: increase in intensity of cultivar-specific color.
87	Maturity of fruit	Fruit ripe for picking
89	Maturity of fruit	Fruit ripe for consumption, fruit has typical taste and firmness, beginning of senescence and fruit abscission.
91	Senescence, beginning of dormancy	Shoot growth completed; terminal bud developed; foliage still fully green.
92	Senescence, beginning of dormancy	Leaves begin to discolor
93	Senescence, beginning of dormancy	Beginning of leaf fall, abscission of older leaves.
95	Senescence, beginning of dormancy	50% of leaves discolored
97	Senescence, beginning of dormancy	All leaves fallen.
99	Senescence, beginning of dormancy	Harvested product

Table 2. Apple Fruit Growth Development Stages. (Adapted from P. Chapman and G. Catlin. 'Growth Stages in Fruit Trees', From Dormant to Fruit Set. New York Food and Life Sciences Bulletin, No. 58, February 1976, New York State Agricultural Experiment Station, Geneva, NY and Michigan State University Extension Service website http://web1.msue.msu.edu/fruit/applgrw.htm)

APPLE (Red Delicious)		**Notes**
Dormant	 	No swelling visible
Silver Tip	 	Swollen buds become noticeable and silvery fuzzy leaf tissue begins to emerge from the tip of the bud.
Green Tip		Green leaf tissue is visible at the tip of the bud.

APPLE (Red Delicious)		**Notes**
		
Quarter Inch Green		A quarter inch of green tissue is visible at the tip of the bud.
Half Inch Green	 	A half inch of green tissue is visible. Leaves start to fold back from the bud. This stage is often called "Mouse Ears".
Tight Cluster		The spur leaves have folded back exposing the flower cluster inside the bud.

APPLE (Red Delicious)		**Notes**
		
Pink	 	The flower buds have grown enough to expose the petals of the flowers.
Open Cluster		The individual flower buds have separated.
King Bloom		The center "King Bloom" has opened. The King bloom has the potential to have the largest fruit.

APPLE (Red Delicious)		**Notes**
Full Bloom	 	60 - 80% or more of the flowers on the tree or in the orchard are open.
Petal Fall	 	Flower petals are falling from the tree. Sprays after petal fall are often referred to as "cover sprays."

APPLE (Red Delicious)		**Notes**
8 mm Fruit		The number refers to fruit diameter in millimeters. Six or eight mm is the beginning of the apple thinning window.
10 mm Fruit		Apple fruit are easiest to spray thin when they are 10 to 15 mm in diameter.
12 mm Fruit		As the fruit cluster develops size difference between the king and side blooms become more pronounced.
15 mm Fruit		"June drop" describes the fall of smaller fruit from the flower cluster early in development. Spray thinners enhance this natural fruit drop and control the crop.
18 mm Fruit		By the time the fruit are this size they are hard to thin and growers use higher unpredictable rates, in an effort to reduce the crop.

APPLE (Red Delicious)		**Notes**
21 mm Fruit		The end of the June drop marks the end of the thinning window.
1.0" Fruit		By the time the fruit is one inch in diameter the final fruit count as been determined. Some growers will thin by hand.
1.25" Fruit		Fruit growth seems to slow down as the fruit enlarges. Actually the amount of growth stays the same but since the fruit is larger the growth seems slower.
1.5" Fruit		
1.75" Fruit		
2.0" Fruit		
2.25" Fruit		

APPLE (Red Delicious)		**Notes**
2.5" Fruit		These fruit are nearing harvest. Two and a half inches is about the smallest commercial size in fresh market fruit.
2.75" Fruit		
3.0" Fruit		
3.25" Fruit		
3.5" Fruit		
3.75" Fruit		
Harvest		Final fruit size is a result of the number of fruit on the tree and the growing conditions that year.

Table 3. Pear Fruit Growth Development Stages. *(*Adapted from P. Chapman and G. Catlin. 'Growth Stages in Fruit Trees', From Dormant to Fruit Set. New York Food and Life Sciences Bulletin, No. 58, February 1976, New York State Agricultural Experiment Station, Geneva, NY) and Michigan State University Extension Service website http://web1.msue.msu.edu/fruit/applgrw.htm).

PEAR (Bartlett)		
Dormant		No swelling visible
Bud Swell		As the buds swell, the light colored edges of the bud scales become visible.
Bud Burst		The bud pops open and the flowers cluster emerges.
Green Cluster		At green cluster the flower cluster is easily recognizable

PEAR (Bartlett)		
White Bud		The flower buds have grown enough to expose the white petals of the pear flowers.
Popcorn		The flower petals form a hollow ball that resembles popped popcorn.
First Bloom		The first flowers are opening.
Full Bloom		80% or more of the flowers on the tree or in the orchard are open.
Petal Fall		Flower petals are falling from the tree. Sprays after petal fall are often referred to as “cover sprays.”
8 mm Fruit		The number refers to fruit diameter in millimeters. Late bloom after the bloom period is over is called 'rat tail bloom' and seldom develops fruit.

PEAR (Bartlett)		
10 mm Fruit		
12 mm Fruit		
15 mm Fruit		
18 mm Fruit		
21 mm Fruit		
1.0 to 3.75" Fruit		
Harvest		

Table 4. Comparison of the Terminology Used for the Pome Fruits Apple and Pear Growth Stages.

APPLE	NOTES	PEAR	NOTES
Dormant	Overwinter stage, fruit buds inactive. No bud swelling visible.	Dormant	Overwinter stage, fruit buds inactive.
Silver Tip	Applies only to apple. Fruit bud scales separated at tip, showing light gray tissue. Swollen buds become noticeable and silvery fuzzy leaf tissue begins to emerge	Bud Swell or Swollen bud	Applies to all fruits except apple. Swollen Bud is equivalent to silvertip stage in apple. Fruit buds swollen, scales separated to expose areas of lighter colored tissue.

APPLE	NOTES	PEAR	NOTES
	from the tip of the bud.		
Green Tip 0.25" Green 0.5" Green	Applies only to apples. Fruit buds broken at tip, which shows about 1 /16 inch (1 - 2 mm) green. At the 0.5 inch green stage a half inch of green tissue is visible at the midtip. Leaves start to fold back from the bud. This stage is often called "Mouse Ears".	Bud Burst	Applies to pear, and is equivalent to green tip stage in apple. Fruit buds broken at tip, showing tips of blossom buds.
Tight Cluster	Applies only to apple. Blossom buds mostly exposed, tightly grouped, stems short.	Green Cluster	Applies only to pear. Blossom buds green, mostly separated in the cluster, stems lengthened.
Open Cluster	The individual flower buds have separated.	White Bud	Applies to pear. Blossom buds white, separated in the exposed cluster and stems lengthened.
Pink	The flower buds have grown enough to expose the petals of the flowers.	Popcorn	The flower petals form a hollow ball that resembles popped popcorn
King Bloom	The center "King Bloom" has opened. The King bloom has the potential to have the largest fruit	First Bloom	The first flowers are opening
Full Bloom	Blossom buds fully open, 60 - 80% or more of the flowers on the tree or in the orchard are open.	Full Bloom	Blossom buds fully open 80% or more of the flowers on the tree or in the orchard are open.
Petal Fall	Flower petals begin falling from the tree. Stage after about 75 per cent of the petals have fallen applies to all fruits. Sprays after petal fall are often referred to as “cover sprays.”	Petal Fall	Flower petals are falling from the tree. Stage after about 75 per cent of the petals have fallen applies to all fruits. Sprays after petal fall are often referred to as “cover sprays.”
8 mm Fruit	The number refers to fruit diameter in millimeters. Six or eight mm is the beginning of the apple thinning window	8 mm Fruit	The number refers to fruit diameter in millimeters. Late bloom after the bloom period is over is called 'rat tail bloom'

APPLE	NOTES	PEAR	NOTES
			and seldom develops fruit.
10 mm Fruit	Apple fruit are easiest to spray thin when they are 10 to 15 mm in diameter.	10 mm Fruit	Pear fruit expanding in diameter.
12 mm Fruit	As the fruit cluster develops size difference between the king and side blooms become more pronounced.	12 mm Fruit	
15 mm Fruit	"June drop" describes the fall of smaller fruit from the flower cluster early in development. Spray thinners enhance this natural fruit drop and control the crop.	15 mm Fruit	
18 mm Fruit	By the time the fruit are this size they are hard to thin and growers use higher unpredictable rates, in an effort to reduce the crop.	18 mm Fruit	
21 mm Fruit	The end of the June drop marks the end of the thinning window.	21 mm Fruit	
1.0" Fruit	By the time the fruit is one inch in diameter the final fruit count as been determined. Some growers will thin by hand.	1.0" Fruit	
1.25" Fruit	Fruit growth seems to slow down as the fruit enlarges. Actually the amount of growth stays the same but since the fruit is larger the growth seems slower.	1.25" Fruit	
1.5" Fruit		1.5" Fruit	
1.75" Fruit		1.75" Fruit	
2.0" Fruit		2.0" Fruit	

APPLE	NOTES	PEAR	NOTES
2.25" Fruit		2.25" Fruit	
2.5" Fruit	These fruit are nearing harvest. Two and a half inches is about the smallest commercial size for fresh market apples.	2.5" Fruit	
2.75" Fruit		2.75" Fruit	
3.0" Fruit		3.0" Fruit	
3.25" Fruit		3.25" Fruit	
3.5" Fruit		3.5" Fruit	
3.75" Fruit	Maximum fruit size.	3.75" Fruit	Maximum fruit size.
Harvest	Final apple fruit size is a result of the number of fruit on the tree and the growing conditions that year.	Harvest	Reach final size ready for pear harvest.

Apples may have pesticide applications or various cultural practices conducted at several growth stages depending upon pest or physiological problem (s) to be controlled. Using integrated pest management practices, pest populations are carefully monitored before a pesticide application is recommended. Again not all of the growth stages of apples will receive a pesticide treatment, but are listed for guidance when the pesticide label lists them as a spray application for the specific growth stage or timing (Table 5).

Table 5. Days Between Growth Stages of Apples.

GROWTH STAGE	DESCRIPTION	DAYS BETWEEN GROWTH STAGE	CUMULATIVE MATURITY DAYS	NOTES
Dormant	Before buds Swell or break	0	0	Early April
Silver Tip	After buds swell or start to open, before bud break	7	7	

GROWTH STAGE	DESCRIPTION	DAYS BETWEEN GROWTH STAGE	CUMULATIVE MATURITY DAYS	NOTES
Green Tip	Reported as green, ¼ or green, ½ inch. First visual green leaf tip tissue.	7 – 14	14 - 21	
Tight Cluster	Flowers still arranged in a cluster and are unopened.	7	21 – 28	
Prepink	When the center flowers or blooms first show pink	4 – 7	25 – 35	Also considered the open cluster stage.
Pink	Just before full bloom, flower buds are pink	7	32 - 42	
Bloom or Full Bloom	All flowers opened	2 – 4	34 – 46	Covers a period of 10 days. Insecticides are not recommended at the bloom stage to prevent killing pollinator insects.
Petal Fall	Most of the flower petals have fallen	7	41 – 53	
First Cover	Leaves are fully developed	10 – 14	51 – 67	Cover sprays can be applied at biweekly periods until harvest
Second Cover	Same cover spray	10 - 14	61 - 81	
Third Cover		10 - 14	71 – 95	
Fourth Cover		10 – 14	81 – 109	The fourth cover spray until 10 to 14 days before

GROWTH STAGE	DESCRIPTION	DAYS BETWEEN GROWTH STAGE	CUMULATIVE MATURITY DAYS	NOTES
				harvest are also called "summer cover sprays."
Fifth Cover		10 – 14	91 – 123	
Sixth Cover		10 – 14	101 – 137	
Seventh Cover		10 – 14	110 – 151	
Eight Cover		10 – 14	120 – 165	
Ninth Cover		10 – 14	131 – 179	
Harvest		7 – 14	137 – 193	

CLIMATE AND SOILS AFFECT POME FRUIT ADAPTATION TO CERTAIN REGIONS:

Apples are adaptable to various climates, but can be considered best adapted to the cool temperate zone from about 25 - 52° latitude. They have a more northern range than many other tree fruits due to relatively late blooming and extreme cold hardiness. Apples reach maturity about 120 - 150 days after bloom, with some cultivars maturing in as short as 70 days, and others as long as 180 days. Apples are grown on a wide variety of soils worldwide, but they prefer well-drained, loamy soils with pH 6 - 7. A minimum rooting depth of 4 - 5 feet is desirable. Trees on shallow soils will be more affected by drought and by root injury during extended severe cold spells. Apple trees will not tolerate waterlogged soils for extended periods during the growing season. Loquat also prefers a deep, well-drained, loamy soil with a pH 6 – 7, and they tolerate temperatures down to -11°C (12°F), but flower buds will be killed at -2 to -7°C (18 - 28°F). Because flowering occurs in late autumn, frost kills the open flowers nearly every year when grown outside the tropics, so fruiting is rare outside of Florida, coastal Georgia, and California in the US. Pears tolerate heavy, poorly drained soils better than most tree fruits. Productivity is best on deep, well-drained loams with pH 6 - 7. Pears have very similar climatic requirements to apples, but are much more susceptible to fire blight so they cannot tolerate humid, wet springs. Asian pears have lower chill requirements than pears and can be grown as far south as northern Florida. Pears have similar or slightly lower cold hardiness than apples, tolerating 10 to -20 F. Pears bloom one to three weeks before apple, and are therefore prone to frost damage in most regions. Pears can mature in as little as 90 days, or as long as 200 days. 'Bartlett' pear is referred to as "summer pears" since they ripen in July - August in California (115 - 140 days). 'Winter pears' are those harvested in autumn and marketed throughout the winter months, such as 'Anjou', 'Bosc', 'Comice', 'Hardy', 'Winter Nelis', and 'Packham's Triumph'.

U.S./NAFTA AND WORLD PRODUCTION AND GEOGRAPHICAL DISTRIBUTION OF THE POME FRUIT COMMODITIES:

Proposed members of the Pome fruit crop group find widespread distribution throughout the world. Pome fruits are one of the largest fruit crops produced in the world, next to grape, banana, and citrus. Table 6 provides a list of the hectares and production in metric tons from various countries that are members of the International Crop Grouping Consulting Committee (ICGCC) as countries that grow apples, pears, and quince. While the world total acreage for apples, pears, and quinces have decreased from 7,817,276 ha in 1995 to 6,681,092 ha in 2007, however the total production of these fruits has increased from 63,428,802 metric tons in 1995 to 84,719,870 metric tons in 2007 (FAO 2005; Table 6). Some "minor" pome fruits commodities have also become more popular. This is an indication of improved productivity. Worldwide, the apple is by far the most harvested pome fruit at 74 % of the hectares followed by pear at 25 %, and by quince at < 1.0 %. The average yields in Mt/ha for the major pome fruits is 12.1 for apple, 11.2 for pear, and 7.1 for quince. Asia is the predominant pome fruit producing regions accounting for 62 % of the apples hectares and 56 % of the production (Mt), 79% of the pear hectares and 69 % of the production, and 57 % of the quince hectares and 60 % of the production. The United States has 6.7 % of their total world hectares for apples and accounts for 6.7 % of the total production (Mt), while it accounts for 1.5 % of the total world hectares and 3.8 % of the total world production (Mt).

Table 6. Major Pome Fruit Production in 2007.
(FAO 2005; NAGASAWA 2006c, Norden, 2005c)

Countries/ Regions	Apple	Pear	Quince
Africa	124,980 ha 1,863,070 Mt	47,240 *ha* 611,828 *Mt*	4,560 *ha* 39,160 *Mt*
C. America	63,160 *ha* 635175 *Mt*	4,850 *ha* 30,500 *Mt*	700 *ha* 7,200 *Mt*
S. America	141,097 *ha* 4,032,227 *Mt*	33,507 *ha* 815,147 *Mt*	4,448 *ha* 38,016 *Mt*
Canada	17,705 *ha* 405,089 *Mt*	1,147 *ha* 13,381 *Mt*	No data
Mexico	60,000 *ha* 605,000 *Mt*	4,850 *ha* 30,500 *Mt*	700 *ha* 7,200 *Mt*
Asia	3,068,586 *ha* 38,522,314 *Mt*	1,364,149 *ha* 14392003 *Mt*	44,233 *ha* 324,768 *Mt*
Australia	20,000 *ha* 221000 *Mt*	7,000 *ha* 150,000 *Mt*	No data
Europe	1,319,129 *ha*	208,706 *ha*	10,475 *ha*

Countries/ Regions	Apple	Pear	Quince
	13,950,045 *Mt*	3,133,284 *Mt*	80,523 *Mt*
Japan	41,000 *ha*[1] 850,000 *Mt*	17,000 *ha* 325,000 *Mt*	40 *ha* 300 *Mt*
New Zealand	10,000 *ha* 380,000 *Mt*	800 *ha* 35,000 *Mt*	70 *ha* 1,000 *Mt*
U.S.	156,000 *ha* 4,237,730 *Mt*	28,000 *ha* 799,180 *Mt*	No data
World Total	4,921,117 *ha* 64,248,520 *Mt*	1,695,489 *ha* 19,980,683 *Mt*	64,486 *ha* 490,667 *Mt*
Comparing World Total in 1995	6,318,724 *ha* 50,298,738 *Mt*	1,457,026 *ha* 12,835,108 *Mt*	41,526 *ha* 294,956 *Mt*

In the U.S pome fruits are widely consumed with the per capita consumption in 2006 for the following pome fruits reported as apple at 51.2 lb with 35 % from fresh and 52 % from juice, and 8 % from canned apples (Table 7). Consumption of apples since 1970 has increased from 31.2 lb to 51.2 lb per capita due to increased apple juice consumption from 6.4 lb to 26.8 lb/capita. Pears in 2007 accounted for 5.4 lb/year consumption in the diet with fresh pears counting for 57 % and canned pears accounting for 43 % (Table 8). Since 1970 pear consumption has only increased by 0.4 lb/capita, but fresh pears has increased rapidly (1.9 to 3.1 lb/capita) with a decline in canned pear consumption (3.3 to 2.3 lb/capita).

Table 7. Apple U.S. per Capita Consumption (lb/year) for 1970, and 2004 – 2006 (USDA ERS Food Availability, July 2008).

Apple	Fresh	Canned	Juice	Frozen	Dried	Other	Total Apple
2006	17.8	4.2	26.8	0.84	0.93	0.59	51.2
2005	16.7	4.2	22.3	0.66	0.73	0.50	45.1
2004	18.8	4.5	25.3	0.86	0.70	0.45	50.7
1970	17.0	5.6	6.4	0.99	0.90	0.64	31.5

Table.8. Pear per Capita Consumption (lb/year) for 1970, and 2004 – 2007 (USDA ERS Food Availability, July 2008).

Pear	Fresh	Canned	Dried	Total Pear
2007	3.1	2.3	-	5.4
2006	3.2	2.4	-	5.6
2005	2.9	2.3	0.02	5.2
2004	3.0	2.5	0.03	5.5
1970	1.9	3.3	0.06	5.2

[1] Apple data in Japan was from the year of 2004

Based on the USDA CSFII 1994 – 1996, 1998 survey, using two day individual consumption for determined pome fruit consumption (g/day) is listed in Table 9, the highest consumption is for fresh apples with peel at 14.2 g/day and apple juice at 18.5 g/day, followed by the fresh pear at 3.3 g/day. The dietary value of the pome fruits, per 100 gram edible portion is listed in APPENDIX III: Dietary Value of the Pome Fruits. Apple juice accounts for approximately 67 % of the total noncitrus fruit juice consumption.

Table 9. Consumption of the Pome Fruits Based on USDA CSFII 1994 – 1996, 1998 survey.

COMMODITY	CONSUMPTION (g/day)
Apple, dried	0.0843
Apple, dried - babyfood	0.000445
Apple, fruit with peel	14.2
Apple, juice	18.5
Apple, juice - babyfood	0.494
Apple, peeled fruit	0.933
Apple, peeled fruit - babyfood	0.0494
Apple, sauce	3.22
Apple, sauce - babyfood	0.254
Pear	3.36
Pear, dried	0.00578
Pear, juice	0.423
Pear, juice, babyfood	0.0818
Pear, babyfood	0.112

IMPORTS/EXPORTS OF THE POME FRUITS:

Despite the U.S. being a major producer of pome fruits (Table 5) significant amounts of some of the pome fruits are imported. The amount of a commodity can vary widely from year to year based on differences in U.S. production, weather effects, and consumer demand. Apples are the most widely imported pome fruit shipped into the U.S. (Table 10). In 1980 the import share of apple and pear consumption was 4.0 and 3.4 %, while in 2001 it greatly increased to 7.0 % and 20.6 %, respectively. Also in 1980, apple juice consumption due to imports was 19.3 % while in 2001 it increased to 63.4 %. In 2006, 7.1 % of the apple crop consumed was from imports, apple juice 80.2 %, and 23.1 % from fresh pears. In 2007 over 206,563 MT of fresh apples were imported to the U.S. (USDA Foreign Agriculture Trade Statistics, FATUS). Compared to 1975 consumption of fresh apples (2.8 %) and pears (2.6 %) and apple juice (15.3 %) due to imports has greatly increased. Approximately 60 % of the apples were imported from Chile, 23 % from New Zealand, and 15 % from Canada. Frozen apple juice concentrate in 2007 was 169,348 Kiloliter with 43 % Brazil, 37 % from Peoples Republic of China, and 11 % from Turkey, and 5 % from Argentina. Apple juice not frozen in 2007 was 2,113,643 kiloliters with 54 % from Peoples Republic of China 19 % from Argentina, and 17.0%

from Chile. There were 7,118 MT dried apples imported from Chile (43 %), Peoples Republic of China (39 %), and Argentina (16 %). Imported fresh pears in 2006 totaled over 106,887 MT with 49 % from Argentina, 28 % from Chile, 10 % from Republic of Korea, and 8.7 % from Peoples Republic of China. Pear juice has been imported at over 190, 991 KL from Argentina at 56 %, Peoples Republic of China at 38 % and Chile at 4 %. According to the USDA, ERS in 2006 approximately 270,669,000 lb of fresh market apples were imported, and 171,704,000 lb of fresh market pears and quinces were imported. Approximately 425,085,000 single strength apple juices were imported to the U.S.

Table 10. U.S. Pome Fruit Imports for 2005-2006. (USDA NASS, 2008 Fr Nt 1-3, USDA ERS, FTS – 2007, USDA FATUS, 2008).

Fruiting Vegetable	**2005**	**2006**
Apple, fresh	679,095 **(**1,000 lb)	686,791 **(**1,000 lb)
Pear, fresh	171,704 **(**1,000 lb)	197,504 **(**1,000 lb)
Apple, juice	503,458 (1,000 single strength equivalent, gallons)	425,085 (1,000 single strength equivalent, gallons)

The U.S. is also a major exporter of pome fruit commodities (Table 11). In 2007, approximately 172,979 MT of fresh apples were exported to Mexico accounting for 27 %, Canada for 20 %, and Taiwan at 7 % (USDA FATUS). Apple juice exports were over 29,024 KL with Canada accounting for 56 %, Japan at 18 %, Mexico at 7 %, and Republic of Korea for 4.7 % and Dominican Republic at 2.7 %. Over 3,614 MT of dried apples were exported to Canada at 50 %, Mexico at 14 % and Australia at 13 % and 11 % to the United Kingdom. Fresh pears were exported with over 144,443 MT with Mexico accounting for 38 %, Canada for 31 %, Brazil for 6.0 %, and the Russian Federation for 4.0 %. Canned pears also accounted for 6,445 MT of the exports with Canada receiving 51 %, Thailand at 25 %, Mexico at 15 % and Costa Rica and Australia each at 2 %. According to the USDA, ERS in 2006 approximately 1,408,859,000 lb of fresh market apples were imported, and 300,506,000 lb of fresh market pears and quinces were exported. Approximately 7,028,000 single strength apple juices were exported. Pear had over 7,058 (1,000 single strength equivalent, gallons) exported to other countries.

Table 11. U.S. Pome Fruit Exports, Metric Tons (MT) for 2005-2006 (USDA NASS, 2008 Fr Nt 1-3, USDA ERS, FTS – 2007, USDA FATUS, 2008).

Pome Fruit	**2005**	**2006**
Apple, fresh	270,669 (1,000 lb)	345,440 (1,000 lb)
Pear, fresh	318,210 (1,000 lb)	300,748 (1,000 lb)
Apple, juice	6,927 (1,000 single strength equivalent, gallons)	7,058 (1,000 single strength equivalent, gallons)

U.S. POME FRUIT PRODUCTION AND GEOGRAPHICAL PRODUCTION:

Production in the U.S. is based on the USDA 2006 Agricultural Statistics, FAO Statistics, 2007, USDA ERS 2007 Noncitrus Fruits Summary, USDA NASS Crop Production, 2007, and the U.S. Agricultural Census, 2002: According to the 2002 AGCensus pome fruits (apples and pears) were grown on over 544,826 A. The planted acreages for the pome fruits in the United States are listed in Table 12. Apples are grown commercially in 35 states. Over 37 % of the apple acres are in Washington followed by New York and Michigan at 11 % each (Table 13). Washington State produces over 71 % of the total U.S. fresh market apple production followed by New York at 11 %, Michigan at 4.4 %, California at 2.5 %, and Pennsylvania at 2 %. Apple yield/acre averages 12.6 T/A, while the average yield/A for pears is14.7 T/A (Table 12). The top pear producing states is Washington with 40.3 % of the total U.S. acres, while California and Oregon each have over 26 % of the pear acres (Table 14). Pear yields will depend on the state where they are grown and range from 5 to 16.8 T/A.

. A map of the harvested apple acres is found in Appendix I, Figure 1, and harvested pear acres in Appendix I, Figure 2.

Table 12. U.S. Pome Fruit Planted Acres in 2002 (AGCensus, 2002) and Domestic Production for 2007 (USDA NASS, 2007, USDA Agricultural Statistics, 2007).

POME FRUIT	PLANTED ACRES (A)	PERCENT OF TOTAL POME FRUIT ACREAGE	DOMESTIC POME FRUIT PRODUCTION (Tons 2005)	YIELD PER ACRE (Tons)
Apple	464,025	85.1 %	4,801,300	12.6
Pear	80,801	14.8 %	1,145,100	14.7
TOTAL	544,826	99.9 %	5,946,400	-

Table 13. Top U.S. States in Production of Apples.
(USDA AG Census, 2002, (USDA NASS, 2007, USDA Agricultural Statistics, 2007).

STATE	APPLE ACRES (A)	STATE PERCENT OF TOTAL U.S. APPLE ACRES
Washington	172,810	37 .7 %
New York	53,233	11.5 %
Michigan	50,539	10.9 %
California	38,268	8.2 %
Pennsylvania	28,110	6.1 %
Virginia	19,331	4.2 %
North Carolina	8,538	1.8 %

STATE	APPLE ACRES (A)	STATE PERCENT OF TOTAL U.S. APPLE ACRES
Ohio	8,485	1.8 %
Oregon	7,237	1.6 %
Wisconsin	6,797	1.5 %
Massachusetts	4,479	1.0 %
Illinois	3,926	0.8 %
Total	464,025	

Table 14. Top U.S. States in Production of Pears and Yield/A. (USDA AG Census, 2002, USDA Agricultural Statistics, 2007).

STATE	PEAR (A) 2002	STATE % OF ACRES	YIELD/ACRE (2007)
Washington	30,979	40.3 %	14.8
California	20,349	26.5 %	16.8
Oregon	20,035	26.1 %	14.0
New York	1,986	2.6 %	9.2
Pennsylvania	1,287	1.7 %	5.0
Michigan	1,128	1.5 %	5.3
Texas	668	0.9 %	-
Virginia	356	0.4 %	-
Total	76,788		-

Over 99 % of the apples produced are utilized fresh or processed. Over 94 % of the pear production is utilized. The apple and pear crops (Table 15) are utilized for juice (51 %), fresh market (37 %), canned (9 %), dried and frozen at 1.0 % each, and for fresh slices (< 1.0 %).

Table15. Apple and Pear Processed Utilization (million pounds) for Canned, Juice and Cider, Frozen, Dried, and Fresh Slices.

Use and State	Utilized Quantity 2006 in million pounds	Utilized Quantity 2007 in million pounds
Canned U.S.	1,164	1,055
MI	215	170
NY	300	320
PA	258	230
VA	150	120
Juice and	1,561	1,264

Use and State	Utilized Quantity 2006 in million pounds	Utilized Quantity 2007 in million pounds
Cider		
WA	700	450
MI	175	140
NY	190	220
PA	67	90
Frozen	199	178
NY	50	50
Apple Dried	253	204
Pear, Fresh Slices	190	215
Pear, Dried (tons)	400	NA

The percent of the total produce sales for the pome fruits sold in U.S. grocery stores for the years 2005 – 2007 is shown in Table 16 (The Packer, Fairchild, 2007, 2008). Apples account for 7.5% of the total produce pome fruit sales followed by pear and Asian pear. In appears that apples are increasing in popularity from 2005 to 2007 by 0.6 %. The Asian pear is also increasing in number of pounds sold by over 2.6 million during the same time period. The pome fruit group accounts for > 8.7 % of the total produce sold in the U.S.

Table 16. The Packer (Fairchild, 2007, 2008) List the Percent of the Total Grocery Store Produce Sales for the Fruiting Vegetables Sold for the Years 2005 – 2007.

Commodity	Percent of Total Produce Sales – 2005 and Pounds Sold in 2005	Percent of Total Produce Sales – 2006 and Pounds Sold in 2006	Percent of Total Produce Sales – 2007 and Pounds Sold in 2007
Apple	6.9 % and 1,756,026,239 lb	7.2 % and 1,764,619,280 lb	7.5 % and 1,774,338,686 lb
Asian pear	> 0.1 % and 6,669,974 lb	> 0.1 % and 7,274,024 lb	> 0.1 % and 9,265,852 lb
Pear	1.2 % and 274,576,278 lb	1.2 % and 282,567,278 lb	1.2 % and 290,392,821 lb

Specific Pome Fruit Crop Production:

Apple:

Apples are the most important tree fruit produced in the temperate zone. Apples are also grown in EPA Crop Production Regions 1, 2, 5, 9, 10, and 11. Other commercial production regions include significant imports from Canada, New Zealand, Chile, South Africa, China, and Brazil. In 2002 China had produced 20.9 million tons on 2,365,000 ha while the U.S. produced 4.7 million t on 185,000 ha. However, yield in t/ha varied from 8.9 t/ha in China to 25.2 t/ha in the USA. There are over 2000 apple cultivars, with eleven cultivars accounting for over 90 % of the apples sold in the US and worldwide about 40 cultivars supply the commercial world production (Table 17). Of it's over 2.3 million hectares, China has over 45 % of its apple production limited to only the 'Fuji' cultivar. Despite the wide availability of newer apple cultivars, 'Red Delicious' is still the most widely grown cultivar in the world.

Table 17. Worldwide Apple Cultivar Trends, Excluding China. (O'Rourle, 2000, Freere, 2003)

Apple Cultivar	**2000 Estimates Tons (X 1,000) Produced**	**2010 Projected Tons (X 1,000) Produced**
Red Delicious	5,334	5,423
Golden Delicious	4,982	5,212
Granny Smith	1,711	1,828
Idared	1,433	1,148
Fuji	1,633	1,857
Gala	1,688	2,594
Jonagold	1,039	1,208
Jonathan	678	727
Braeburn	429	710
Rome Beauty	565	540
Total	26,313	30,429

Azarole:

Azarole ranges from Europe to western Asia, and is a deciduous tree growing to 10 m and has been long grown in Europe. It is hardy to zone 6 and is not frost tender. It is in flower in June. The scented flowers are hermaphrodite (have both male and female organs) and are pollinated by midges. The plant prefers sandy, loamy and can grow in heavy clay soil. The plant prefers acid, neutral or basic soils and can grow in very alkaline soil. It can grow in semi-shade or no shade. Azarole requires moist or wet soil and can tolerate drought. The plant can tolerate strong winds but not maritime exposure,

and it can also tolerate atmospheric pollution. In South Australia it is listed as a noxious weed. In Asia the fruits are eaten fresh and mixed with sugar to make a sweet wine, jam, or jelly. This plant can also be used as an ornamental for its brightly colored flowers and for wildlife cover.

Crabapple:

Crabapples are native species of apple-like fruits that are grown mostly for pollinators in apple orchards or as an ornamental specimen. There are varieties such as 'Hyslop' and 'Red Siberian' that produce relatively large fruit that can be used as a food crop and are processed for cinnamon apple rings. These are hybrids of native species with apples and in general, the trees are hardier than most apple varieties. These are round yellow fruits 1 to 2 inches in diameter that have a red to maroon blush. Pollinator and ornamental varieties are grown everywhere apples are grown. Crabapples are grown in California, New York, and Washington, and other commercial production regions include British Columbia, Canada.

Loquat:

The loquat is a cold-tender evergreen tree native to Southeast Asia that grows in subtropical areas or tropical highlands. It has been grown in Japan for >1000 yr, where over 17,000 tons are produced annually. Brazil also has some production near Sao Paulo. More commonly, it is grown as an ornamental tree in the southeastern US and California, Mediterranean countries, and some parts of central and South America. Domestic cultivars include 'Champagne', 'Thales', 'Advance', 'Fletcher' and 'Miller'. It is produced in the U.S. in California, Hawaii, and Florida and other commercial production regions include Japan, India, Spain, Pakistan, Turkey, and Israel. Japan grew 1,890 hectares producing 6,730 tons in 2005 (NAGASAWA 2006c). In 2000, the major producing loquat country was China with over 40,000 ha and 200,000 Mt of produce.

Mayhaw:

Mayhaws are native to the United States and are shrubs or round-topped small tree to 30 feet tall. Mayhaws flower early to late February to mid-March in southern Georgia and the fruit ripens mostly in early May but some ripen through June. The fruit is a small pome, yellow to red, acid and juicy, resembling cranberries in appearance. In the U.S. it is grown in North Carolina south to northern Florida and west to east Texas and throughout California. Mayhaws are native to the swamps and lowlands of the Gulf Coast states in the U.S. They have been collected from wild trees in the Deep South since antebellum times, and are rarely cultivated in orchards today. Over 75 varieties have been developed since 1986. In China there were 240 million trees and 4,500 million pounds of fruit annually in 1996. Mayhaws are native to north temperate zone.11 and to temperate zones of China. EPA production Regions are 2, 3, 4, and 6.

Medlar:

The Medlar is native to the eastern part of the Mediterranean and the eastern part of Turkey. This plant is small, flat topped, deciduous tree that grows to 20 feet high. It is a close relative of hawthorn which lacks thorns. In late spring, large white or slightly pink blossoms are borne singly on ends of short shoots and almost every flower sets fruit. The fruit is 1 to 2½ inches in diameter and resembles a small russet apple, tinged dull yellow or brown color with the calyx end flared open. The flesh is as soft as a baked apple. Embedded in the pulp are five large stone like seeds. Fruit are best picked at early leaf drop prior to heavy frost. At harvest, the fruit are rock hard and must soften prior to consumption. Ripening takes two weeks to one month after harvest. . The wood of the medlar is used for spears and walking canes. Cultivation is still common in France and Germany.

Pear:

Pears are a temperate zone fruit and grown on a wide variety of soils. They are similar to apples in many respects. The tree is of medium size, up to 30 to 40 feet in height, but usually held to under 20 feet by pruning. They differ from apples in having "grit" cells in the flesh of the fruit. In general, pears are pyriform in shape, tapering toward the stem, although some varieties are nearly round. Fruit size varies in varieties from less than 2 inches in diameter up to 3 inches. Fruit surface in some varieties is russet but in others is free of russet and covered with a thin layer of wax. Trees tend to be more upright than apples. Pears can be classified by maturity date; summer, autumn and winter. They are the only temperate tree fruit that cannot be left on the tree to ripen. Major production in U.S. is of the common or European pear. Major commercial varieties/types of this pear include: ‘Anjou’, ‘Bartlett’, ‘Bosc’, ‘Comice’, and ‘Seckel’. Days after full bloom to harvest for the varieties range from 110 – 150 days. There are significant imports from Chile and Argentina. Other growing regions of pears include Australia, Canada, Japan, New Zealand, South Korea, South Africa and Europe. EPA Crop Production Regions for pears includes Regions 1, 10, and 11.

Pear, Oriental (Asian):

Most cultivars of the Oriental pear, now called Asian pears do resemble apples in that they have fruit that are round and have a crunchy texture. The Japanese cultivars tend to be more circular in shape, while the Chinese cultivars are more oval or pyriform (pear-shaped). All Asian pear cultivars should be considered self-incompatible. Mature trees can reach heights of more than 20 feet. Asian pears comprise a large group of pears that are crisp in texture and, when mature, are good to eat as soon as harvested or for several months after picking if held in cold storage. This ready-to-eat feature may make them more acceptable to some people than European pears that are usually served when

soft and juicy, which condition takes about a week to occur after removal from cold storage. There are three types of Asian pears based on shape and color. These are: (1) round or flat fruit with yellow to green fruit; (2) round or flat fruit having a bronze colored skin with rusetting, and (3) pear shaped fruit with either smooth or russeted skin. Asian pears have been grown commercially in Asia for centuries and are very popular in Japan, China, and Korea. Most new Asian pear plantings in California are in Fresno, Tulare and Kern Counties. A few plantings exist in Yakima and Wenatchee, Washington, and others are found in Hood River and Willamette Valley in Oregon. In the last few years plantings of Asian pears were made in New Zealand, Australia, Chile, France, and the eastern and southeastern United States. It is roughly estimated that 4,000 - 5,000 acres of Asian pears are planted in California, Oregon and Washington. Since 1984 about 100,000 trees (500 acres) of Asian pears have been planted every year in California. Most popular Oriental pears are 20th Century 'Nijisseiki', 'Kosui', 'Kikusui', 'Hosui', 'Shinseiki', 'Shinsui', 'Shinko', and 'Niitaki'. There are a few cultivars of hybrid origin. Other commercial production regions: Japan grew 15,200 hectares producing 361,400 tons in 2005 (NAGASAWA 2006c), and some fruit is exported to the United States in October and November. China and Korea are also growing these pears for domestic consumption and export to the US and Canada.

Quince:

Quinces are fruits closely related to apples and pears, but are of lesser economic importance. It is thought that it is native to northern Iran and Turkestan. The plants are deciduous thornless shrubs or small trees. Generally they are not over 20 feet high. Fruits are mostly 2 inches up in diameter, covered with pubescence. Fruit color is generally yellow. Fruit flesh is rather hard with a bitter acid taste. The most common cultivars/varieties include "Champion", "Pineapple", "Smyrna" and Van Deman". The quince has been cultivated for over two thousand years for its edible fruit and its seed. It is also much used as a dwarfing rootstock for pears and some other fruits. California is key production area with 100 - 200 acres. No available statistical information from other areas. Other commercial production regions: Mediterranean, Argentina, and the Middle East. Argentina produces over 20,000 t/ha. The largest are of quinces is in the Mediterranean area (35.2%) and China (22.3%).

Quince, Chinese and Quince, Japanese:

The Chinese quince is native to China and Indo-China, and cultivated in Japan. Chinese quince was introduced to Europe in 1796 and Japanese quince in 1869. The crop is cultivated in the north and Eastern Europe including Baltic areas and Latvia. It is hardy to zone 5 and is not frost tender. It is in flower from February to June, and the seeds ripen in October. The flowers are hermaphrodite (has both male and female organs) and are pollinated by bees. It is noted for attracting wildlife. The fruit can be apple or pear-shaped and up to 6.5 cm long x 6.5 cm wide. It is a very ornamental plant and a good bee plant, flowering early in the year and providing pollen and nectar. The

Japanese quince is a closely related species and also occurs in central and south Japan, and it has been planted in Latvia in the 1970's and in 1996 approximately 300 ha had an average yield of 12 – 15 T/ha. It can grow 0.6 – 1.2 m tall and 5 m wide. Commercial production of the Japanese quince is in Belarus, Finland, Germany, and Poland. Other production regions include Japan grew 55 hectares producing 335 tons in 2003. Both of these quinces are also grown for ornamental purposes.

Tejocote:

Tejocote is native to America and it is hardy to hardiness zone 7 and is not frost tender. The flowers are hermaphrodite (has both male and female organs) and are pollinated by insect midges. The plant prefers sandy, loamy and heavy (clay) soils and can grow in heavy clay soil. The plant prefers acid, neutral and basic (alkaline) soils. It can grow in semi-shade or light woodland or no shade. It requires moist or wet soil and can tolerate drought. The plant can tolerate strong winds but not maritime exposure. It can tolerate atmospheric pollution.

COMPARISON OF POME FRUIT CULTURAL PRACTICES:

General Planting Design, Training, and Pruning (adapted from Rieger, 2006, Robinson, 2003, and USDA Crop Profiles, 2003):

Pome fruit orchard planting systems are designed to improve the production efficiency by managing variables of rootstock, tree spacing, arrangement, canopy shape, pruning, tree training methods and support systems.

The more modern planting systems are based on higher tree densities than 50 years ago when the tree density ranged from 70 - 100 tree/ha to today range from 1000 – 6000 trees/ha. The increase in density is due to development of dwarfing rootstocks. In the nursery, apple scions and rootstock are grafted together. A scion is the detached shoot or twig containing buds from a desired tree, used in grafting. Rootstock is selected for tolerance to pressures such as pests or cold, in addition to how well it influences the final tree's vigor, size, and fruit quality. Yields may be realized in the third year after planting compared to 5 - 6 in an older orchard planting density. However, many highly productive commercial orchards today have 150 - 180 trees per acre and higher density could be anything over 180 trees per acre. For the purposes of this publication, there are several characteristics in addition to tree number that are included in a high density orchard system. Besides having an increased number of trees per acre, a high density orchard must come into bearing within 2 - 3 years after planting. Each type of planting system has different pruning and planning plans.

Consistent early fruit production is essential to offset the increased establishment costs. It is also very costly to hold trees on more vigorous rootstocks in an allotted space required for a high density orchard. To maximize the production of a high density orchard, it is also necessary to modify the training system and training and pruning techniques from traditional methods. Since trees will be bearing fruit early, a permanent tree support system is also required. It is essential to crop trees very early in the life of the orchard to offset the costs of establishment and to aid in managing vegetative growth. Early production is directly related to number, the greater the light interception by that acre of land early in the life of the orchard. To the extreme, there are orchards planted in Europe and the Pacific Northwest with 5,000 - 9,000 trees per acre. Although, these orchards may be very productive early in their life, it is doubtful that they would be profitable, or manageable, under economic conditions in the Southeast. Research conducted at Cornell University's Geneva Research Station in New York found that for the first seven years of an orchard, the yield increased with tree density, independent of the size-controlled rootstock used. The most dwarfing rootstocks produced significantly larger yields in the third year. As tree density increased, profit ability increased up to approximately 1,000 trees per acre. Preliminary studies in North Carolina indicate that tree densities of 450 - 600 trees per acre are most profitable for the Southeast given the climate, soils, and markets.

Orchard planting systems are categorized from tree canopy shapes. Four basic canopy shapes are: spherical, conic, flat-fan, and Y - or V - canopy shapes. The spherical shaped canopy system was most common in early 1900's and contained a large tree with a height of 6 - 8 m and a main trunk diameter of 1.8 – 2.0 m. These large globe canopies took 10 – 15 years to produce high yields. Primary advantage of the spherical shapes is that they are the natural shape of an apple tree. This system was replaced in the mid 1900's and in the early 1960's the conic system developed as an improved tree form to allow more light penetration through the canopy. The mini-central leader system was developed at Cornell University to have semi-dwarf trees supported with a 2.5 m tree spike supporting the trees and ranging from 500 – 1000 trees/ha. The spindle bush system was also developing in the early 1960's designed to improve yields and it became the dominant planting system in Europe. The trees are fully dwarf, narrow, cone shaped trees to allow for high density plantings ranging from 1500 – 4000 trees/ha. The narrow slender shape of the canopy helps the leaves to be well exposed to sunlight. The conic shaped system are currently the dominant tree form in most of the world's apple growing regions and allows the tree to grow in a fairly natural shape with minimal labor allowing good light penetration throughout the canopy, but the upper branches of the tree as they mature may begin to shade out the lower limbs. The slender spindle is most common in Northern Europe and the vertical axis system is most common in the rest of the world. The flat fan canopy systems utilize trellis to improve labor efficacy. This tree system trains a tree to a 3 m tall using a 4 – 6 wire vertical trellis which also serves to support the tree. Tree height is maintained at 4 – 5 m and densities of 100 - 2000 trees/ha. Common tree spacings are 1.5 – 2.5 m in the row and 3 – 4 m between rows. The advantage of the flat fan systems is the ease of tree training and to help mechanize orchard picking

operations as well as allow good light penetration within the canopy. The disadvantages of flat systems are the labor costs to maintain the canopy and low tree planting densities. The V shaped apple canopies became popular with the development of the Tatura trellis in 1970's to utilize dwarfing rootstocks. They are categorized by tree shape and branch training protocols using either a V- shape of Y- shape tree. The Y- shaped trees have a vertical trunk with the arms or limbs trained to either side of the trellis. The V- shaped trees have the whole tree leaned to one side of the trellis while the next tree in the row leans to the opposite side of the V - trellis. The Tatura trellis keep the trees headed at 50 cm height with 6 wires per side and close in row spacings of 1 m with 5 m between rows. The Geneva trellis system is aY - shaped system trained in a more fan type position with a 2 m tall trellis and three wires per side with 1.5 – 1.8 m in row spacings and 4 m between rows. The V - shaped systems have become very popular over the last 25 years because they have high yields at maturity and allow good light penetration. With a vertical trunk and is conducive to use of mechanical equipment between rows. Also less fruit sun scald occurs in this type of trellis system. The disadvantage of the V systems is the initial cost of establishment and tree training, and while fruit size may be smaller than with other training systems, the yields may be higher with this system.

Efficient use of labor to harvest and prune from the ground or from a short stool is another advantage of using a high density system. It is difficult to find workers who are willing to climb ladders to work in traditional orchards in today's market, not to mention the liability that must be assumed for their employees. Another advantage is the potential to have higher quality fruit for a longer period of time by maintaining light interception in the smaller trees of higher density orchards. Pesticide application efficiency may be much higher in higher density orchards as well. Although there are many advantages to high density orchards, the disadvantages must also be considered. The primary disadvantage is the high cost of planting orchard establishment. High density orchards are also unforgiving in terms of lack of management systems require more training and minimal pruning during the first 6 years than traditional systems, especially during the summer. Another potential disadvantage involves re-educating orchard managers and workers in the training and pruning techniques required for higher density orchards.

The ideal site for a pome fruit orchard is an area of rolling land. Plant pome fruits on slopes that are not too steep to be safely traversed with equipment. The tops of hills are not necessarily good sites as orchards located there are more vulnerable to freezes than the sides of hills. Also, soils on the tops of hills are frequently shallow due to erosion.

Specific Individual Pome Fruit Cultural Practices:

Apple:

Small to medium sized tree with spreading canopy, to 30 ft in wild, generally are maintained to 6 - 15 ft in cultivation. Tree size and shape is heavily dependent on rootstock and training system. Leaves are elliptical with serrate margins, dark green with light pubescence on underside. Petals are white when open, but have red-pink undersides when opening, hence the "pink" bloom stage. The ovary is inferior, embedded in the floral cup or hypanthium, containing 5 locules, usually 2 ovules per locule. The inflorescence is a cyme of 4 - 6 flowers, with the center flower opening first; the central flower is often called the "King bloom", and has the potential to produce a larger fruit than other flowers. Flowers are produced terminally from mixed buds (containing both leaves and flowers) on spurs, or to a lesser extent on long shoots. Spurs form on two year old and older wood, and generally grow only a fraction of an inch each year. Fruiting begins 3 - 5 years after budding, although a few fruit may be produced in the second year. This varies with rootstock (dwarfing) and cultural practices (excessive pruning = delay). Fruit are usually thinned to 1 per spur, with spurs spaced 4 - 6 inches apart for attainment of marketable size. Apples are generally thinned with chemicals such as the insecticide carbaryl or the synthetic auxins such as naphthalene acetic acid (NAA).

The apple tree is of medium size, up to 30 to 40 feet in height, but usually held to under 20 feet or less by pruning. They are propagated by budding or grafting onto rootstocks. Leaves are entire and up to 4 inches long, pubescent when young, near glabrous later. The fruits are oblate to slightly conic in shape, with depressions at the stem and calyx ends, 2 1/4 up to 3 1/2 inches in diameter. They consist of a thin outer peel, a thickened edible flesh and a central core of 5 carpels, in which the small seeds are borne. The peel is pubescent when young, later becoming smooth and waxy. Formerly some russeted varieties were grown. These have disappeared in commercial orchards, but russeted areas may occur on some varieties due to weather or other injury. Important commercial varieties/types include: ‘Braeburn’, ‘Crispin’, ‘Mutsu’, ‘Empire’, ‘Fuji’, ‘Gala’, ‘Golden Delicious’, ‘Granny Smith’, ‘Ida Red’, ‘Jonagold’, ‘Jonathan’, ‘McIntosh’, ‘Red Delicious’, and ‘Rome’. Throughout its history of cultivation, at least 10,000 apple cultivars were developed, many of which are now lost. Apples are adaptable to various climates, but can be considered best adapted to the cool temperate zone from about 35 - 50° latitude. After planting rootstocks full production may not occur until 5 – 6 years later. Bloom to harvest in 70 to 170 days, depending on variety and location. For example Red Delicious is harvested 140 – 160 days after full bloom (Table 18). The maturity dates for each apple cultivar will vary depending upon the environmental conditions (temperature, rainfall, soil types) in the Region where they are grown. Some representative examples and ranges of apple cultivar maturity and days after full bloom to harvest are listed in Table 18, and to determine the number of days from petal fall to harvest for a specific apple cultivar and you would subtract seven days from the days after full bloom (DAFB). Apples are T- or chip-budded in the nursery, and

sold as 1-year-old whips on 1.5 to 2-year-old rootstocks. Rootstocks are also produced vegetatively, generally by mound layerage. The range of rootstocks available for apple permits a wide variety of orchard designs and tree training systems. In most cases, trees are grown in rectangular arrangements or hedgerows. Conventional apple orchards on seedling rootstocks require spacings of 20 x 20 (110 trees/acre) to 40 x 40 ft (27 trees/acre). More intensive orchards (400 trees/acre) are generally planted to form hedgerows or solid rows of fruiting wood where individual trees lose their identity. Apples must be picked by hand to avoid bruising and reduction of fresh market quality grade. Fruit must be picked carefully to avoid damaging the spur, where next season's fruit will be borne.

Table 18. Days from Full Bloom to Harvest for Various Apple Cultivars.

Apple Cultivar	Bloom Timing	Days from Bloom to Harvest	Harvest
Braeburn	Midseason	150 - 185	Late October
Cameo	Midseason	155 - 165	Mid. October
Cortland	Midseason	125 - 140	Mid October
Elstar	Mid- late season	110- 150	Early September
Empire	Midseason	125 - 140	Early October
Freedom	Mid- late season	140 - 155	Late September
Fuji	Mid- late season	140 - 185	Late October – mid. November
Gala	Midseason	110 - 140	Late August
Ginger gold	Midseason	95 - 105	Early August
Golden Delicious	Midseason	135 - 160	Mid. September to early October
Granny Smith	Late season	165 - 180	Early November
Gravenstein	Early season	110 - 115	Early September
Honeycrisp	Early season	125 - 140	Mid. September
Idared	Early season	145 - 160	Early October
Jonagold	Midseason	135 – 160	Late September
Jonathan	Midseason	135 - 160	Mid-late September
Liberty	Early season	120 - 135	Late September
McIntosh	Midseason	120 – 145	Mid September
Mutsu (Crispin)	Midseason	160 - 170	Late October
Paulared	Early season	95 - 105	Early September
Pink lady	Mid-late season	180 - 195	Mid–late September
Red delicious	Midseason	135 -160	Late September
Rome Beauty	Late season	160 - 175	Late October
Stayman	Early season	160 - 175	Late October
Winesap	Late season	165 - 180	Late October
York	Midseason	170 - 180	Late October

Azarole:

Azarole is a very easily grown plant; it prefers a well-drained loamy soil. Once established, it succeeds in excessively moist soils and also tolerates drought. It grows well on a chalk soil and also in heavy clay soils and grows up to 10m tall. A position in full sun is best when plants are being grown for their fruit, they also succeed in semi-shade though fruit yields and quality will be lower in such a position. Most members of this genus succeed in exposed positions, they also tolerate atmospheric pollution. The azarole has long been cultivated for its edible fruit in Southern Europe, though it is now not as popular. Seedling trees take from 5 - 8 years before they start bearing fruit, though grafted trees will often flower heavily in their third year. The flowers have a smell somewhat like decaying fish. This attracts midges which are the main means of fertilization. When freshly open, the flowers have more pleasant scent with balsamic undertones. Hawthorns in general hybridize freely with other members of the genus. Seedlings should not be left in a seedbed for more than 2 years without being transplanted. Seed - this is best sown as soon as it is ripe in the autumn in a cold frame, some of the seed will germinate in the spring, though most will probably take another year. Stored seed can be very slow and erratic to germinate, it should be warm stratified for 3 months at 15° C and then cold stratified for another 3 months at 4° C. It may still take another 18 months to germinate. Scarifying the seed before stratifying it might reduce this time. Fermenting the seed for a few days in its own pulp may also speed up the germination process. Another possibility is to harvest the seed 'green', as soon as the embryo has fully developed but before the seed coat hardens and plant it immediately in a cold frame. If timed well, it can germinate in the spring. If you are only growing small quantities of plants, it is best to pot up the seedlings as soon as they are large enough to handle and grow them on in individual pots for their first year, planting them out in late spring into nursery beds or their final positions. When growing larger quantities, it might be best to sow them directly outdoors in a seedbed, but with protection from mice and other seed-eating creatures. Grow them on in the seedbed until large enough to plant out, but undercut the roots if they are to be left undisturbed for more than two years. The crop may grow from 6 – 10 m high, and the fruit will ripen in August – September. The small red fruit has a pleasant aromatic flavor. It ripens in early to mid-autumn. There are yellow, red, and white fruited varieties. Fruits are harvest mechanically or hand picked.

Crabapple:

A crabapple is basically a small apple, and is not as important crop as apples. The plants are grown primarily as ornamentals and cultivars are chosen because of their beautiful flowers, foliage, or fruit, although a few growers produce the fruit commercially. The fruit is preserved or pickled or it is used in making jellies. No production data are available on the quantity of fruit that is used commercially. The general appearance is similar to a small bearing apple tree. Culture is also similar to the culture of apple trees. The flower is similar to that of the apple. The fruit are round

yellow fruits 1 to 2 inches in diameter that have a red to maroon blush. Crabapples are native species of apple-like fruits that are grown mostly for pollinators in apple orchards or as a beautiful ornamental specimen. If commercial fruit production is anticipated, and crabapple trees are grown along with other fruit trees in commercial orchards, there is likelihood that additional pollinating insects will be required. If the grower is providing bees for his other fruits, then he should provide enough for crabapples also. There are varieties such as 'Hyslop' and 'Red Siberian' that produce relatively large fruit that can be used as a food crop and are processed for cinnamon apple slices. Crabapples are considered to be apples except for being less than 2 inches in diameter, but some crabapples are greater than 2 inches in diameter and some dessert apples are small. Western crabapple is native to North America. Shrub or small tree, to 35 feet tall, armed with sharp spur-shoots, the older bark is deeply fissured. Leaves are alternate, deciduous, lance- to egg-shaped, to 10 cm long, pointed at the end, toothed, with irregular lobes; the leaves turn red or yellow-orange in fall. Flowers are white to pink (mid-April/mid-May), showy, calyx of 5 lobes, petals 5, styles 3 - 4 from inferior ovary, numerous stamens. Fruits are pomes, initially green becoming yellow or reddish, to 15mm and egg-shaped, tart. Bloom to harvest in approximately 4 months. Western crabapple is harvested in late summer and early fall. Flower in May. Flowering crabapples may be planted almost any time of the year. Balled and bur lapped stock and containerized trees can be planted any time after spring frosts end through fall until about three weeks before the ground freezes. However, bare root trees should only be planted in the spring. Bare root trees become too stressed if planting is delayed past early spring. Crabapples prefer light (sandy), medium (loamy) and heavy (clay) soils, require well-drained soil and can grow in heavy clay soil. The plant prefers acid, neutral and alkaline soils. It can grow in semi-shade and light woodland or no shade and requires moist soil.

Loquat

Loquat grows in subtropical areas or tropical highlands. Propagated by seed or grafting. The first crop will mature in 2 - 3 years after grafting while trees from seedlings which will take 8 – 10 years to mature. They are extremely long lived up to 90 years. Loquats can be propagated by various grafting methods, including shield-budding or side-veneer grafting and cleft-grafting. The use of loquat seedling rootstock usually results in a comparatively large tree with a high canopy. Cultivars grown on quince rootstock produce a dwarfed tree of early bearing character. The smaller tree has no effect on fruit size and gives adequate fruit production with the advantage of easier picking. Loquat trees are evergreen, rounded in form, up to 30 feet high. Dark green leaves vary from eight inches to a foot long. Trees are spaced about 20 - 25 ft apart in orchards and at a density of 500 – 600 trees/ha. Trees will stand winter temperatures down to about 12 ° F. It prefers a soil ranging from pH of 5.0 – 8.0. Flowering time is unusual; occurs in November - January, depending on location. Flowers open and set fruit in autumn, and if temperatures reach 25 ° F or lower in winter, fruit crop will be lost. Flowers and fruits are produced on large panicles. Individual fruits are pyriform or oval,

l 1/2 to near 3 inches long, and covered with a tough, pubescent skin which separates readily from the pulp when ripe. The fruit is a white or yellow pome, like apple and pear, generally 2 – 5 cm in diameter with 3 to 5 seeds, and with the calyx persistent and weighs 30 – 40g with some cultivars ranging up to 200g. Flesh is firm and creamy, mild, sub-acid in flavor. Domestic cultivars include 'Champagne', 'Thales', 'Advance', 'Fletcher' and 'Miller'. Loquat is propagated by seed or grafting, and the first crop will be in 2 - 3 years after grafting. The crop timing from bloom to maturity is 120 - 200 days. Harvest time in California is from March to June, and in Florida it matures in March and takes 7 – 10 days to harvest the crop. Fruit must be picked by hand to avoid injury and classified by grade based on quality and size. It is eaten out of hand fresh or fruit salads. Also cooked for desserts, sauces or preserves, and are also grown as an ornamental.

Mayhaw:

Mayhaw is a long living ($\geq$ 50 years) perennial shrub or round-topped small tree to 30 feet tall and look similar to crabapple trees. The name "Mayhaw" is a conjugation of the month of ripening (May) and the common name for *Crataegus* spp. (Hawthorn). Mayhaws are a group of species in the genus *Crataegus*, family *Rosaceae*. Primary species include *C. aestivalis*, *C. opaca*, and *C. rufula*. They are closely related to apple and pear, and have been used as exotic dwarfing rootstocks for both. In the U.S. over 75 varieties of mayhaws have been developed. Mayhaws flower early (late February to mid-March in southern Georgia) and the fruit ripens mostly in early May but some ripen through June. The fruit is a small pome that is ½ to 1 inch in diameter, yellow to red, acid and juicy with a whitish pulp, resembling crabapples or cranberries in appearance. Two to five pieces of hard-shelled seeds are located in the center of the fruit. Since mayhaws contain a high red pigment and pectin they are a natural source of color and texture for jelly. The bloom to harvest is about 3 months and some can be harvested for about 30 days. Mayhaws are ripe in April and early May and can be harvested by shaking the tree and catching the fruit by using nets under the tree or by hand. Under natural conditions seed do not germinate until over wintered. Mayhaw softwood stem cuttings can also be rooted under intermittent mist or in a humidity chamber during the summer. Mayhaws are easily grafted during dormancy (late winter). For rootstocks mayhaw appears to be initially compatible with any hawthorn species. A few selections have been made, like the relatively large-fruited 'Texas Superberry' or the even-ripening 'Lodi' Bloom occurs over an extended period of time and the fruit are reported to be fairly frost hardy once past the bloom period. The suggested tree spacing for a permanent orchard is 4.6 - 6.1 m (15 - 20 ft) in the row and 5.5 - 6.1 m (18 - 20 ft) between rows giving 270 - 400 trees/ha or 109 - 161 trees/A. Tree height ranges from 1 – 12 m tall. The fruit is mainly used to make jelly.

Medlar:

This plant is small, flat topped, deciduous tree that grows to 20 feet high, that is native to the eastern part of the Mediterranean and the eastern part of Turkey. Medlar is a close relative of the hawthorn which lacks thorns. In late spring, large white or slightly pink blossoms are borne singly on ends of short shoots. Almost every flower sets fruit. The fruit is 1 to 2½ inches in diameter and resembles a small russeted apple, tinged dull yellow or brown color with the calyx end flared open. The flesh is as soft as a baked apple. Embedded in the pulp are five large stone like seeds. Fruit are best picked at early leaf drop prior to heavy frost. At harvest, the fruit are rock hard and must soften prior to consumption. Ripening takes two weeks to one month after harvest. After harvest the fruits are left until they become brown inside and half rotten and this process is called bletting and this process takes 2 – 4 weeks after harvest. Once bletted the fruit will keep for several weeks and has a taste like applesauce with some cinnamon. Flowering occurs in late May or June and the fruit matures in October to December. The fruits are small in size 1 ½ inch diameter (4 cm), and are left on trees until they are over ripe. The fruit weight can vary from 10 - 80 g and a yield of 30 – 35 kg/tree is possible. The planting site must be in a sunny position and protected from the wind, as the trees are very brittle and susceptible to wind damage. Young trees are best if thinned and pruned to desired shape. Medlars are slow growing but bear fruit at an early age with the tree height dependent on the rootstock. They will reach up to 3.5 m (12 ft) in height when grafted onto a quince rootstock or 4.5 m (15 ft) or taller if grafted onto a pear rootstock and may be productive for more than 30 years. The trees are spaced in the row from 3.5 6.0 m.

Pear:

A medium sized, upright tree growing to 30 ft tall, generally 8 - 18 ft in cultivation. Tree size is heavily dependent on rootstock and training system. Leaves are elliptical to ovate with acute tips, with finely serrate or entire margins, 2 - 4 in length. Flowers are about one inch diameter with white petals, and similar to apple except for having longer pedicels. The inflorescence is corymbose, containing 5 - 7 flowers also different from apple. Pears are a temperate zone fruit and grown on a wide variety of soils. They are similar to apples in many respects. The tree is of medium size, up to 30 to 40 feet in height, but usually held to under 20 feet by pruning. They differ from apples in having "grit" cells in the flesh of the fruit. In general, pears are pyriform in shape, tapering toward the stem, although some varieties are nearly round. Fruit size varies in varieties from less than 2 inches in diameter up to 3 inches. Fruit surface in some varieties is russeted but in others is free of russet and covered with a thin layer of wax. Trees tend to be more upright than apples. Pears can be classified by maturity date; summer, autumn and winter. They are the only temperate tree fruit that cannot be left on the tree to ripen. Major production in U.S. is of the common or European pear. Major commercial varieties/types of this pear include: ‘Anjou’, ‘Bartlett’, ‘Bosc’, ‘Comice’, and ‘Seckel’. 'Bartlett' and its sports are referred to as "summer pears" since they ripen in July - August in California (115 - 140 days). "Winter pears" are those harvested in autumn and

marketed throughout the winter months, such as 'Anjou', 'Bosc', 'Comice', 'Hardy', 'Winter Nelis', and 'Packham's Triumph'. Bloom to harvest in 90 to 200 days (Table 19). The cultivar ‘Bartlett’ has a 110 – 133 day from bloom to harvest, ‘Bosc’ from 130 - 145, and ‘D’Anjou from 120 – 150 days. Pears are propagated by budding or grafting onto rootstocks. T-budded or chip-budded, quince rootstock are generally dwarfing, but sometimes require double budding. Pear orchards are designed very similar to apple orchards. Standard trees are spaced at 25 x 25 ft (70 trees/acre), but hedgerow forms are more common in high density plantings, with hundreds of trees per acre. Pollinizers are planted in alternate rows, or every 10th or 15th tree within hedgerows. The most common system is central leader for free-standing trees and some form of palmette for trellised orchards. Initial tree training is particularly important with pear since scaffolds tend to grow nearly vertically, causing poor crotch angles and delayed fruiting. Other than this tendency to grow upright and therefore greater need for limb spreaders, pears are trained and pruned in the same way as apples. European pears are harvested when "firm mature"; flesh firmness is the most reliable indicator of pear maturity. Firmness in the range of 10 - 15 lbs as measured by a pressure tester is desirable. Pears for are picked by hand several times over a 7 - 20 day period depending upon maturity..

Table 19. Days from Full Bloom to Harvest for Various Pear Cultivars.

Pear Cultivar	Bloom Timing	Days from Bloom to Harvest
Bartlett	Midseason	115 - 170
Seckel	Midseason	120 - 140
Anjou	Midseason	140 - 165
Bosc	Late	150 - 165
Packham’s Triumph	Midseason	150 - 165
Comice	Late	150 – 170
Forelle	Early	160 - 190
Kieffer	Early	170 - 190

Pear, Oriental (Asian):

Most cultivars of Asian pears do resemble apples in that they have fruit that are round and have a crunchy texture. The Japanese cultivars tend to be rounder in shape, while the Chinese cultivars are more oval or pyriform (pear-shaped). All Asian pear cultivars should be considered self-incompatible. Mature trees can reach heights of more than 20 feet and 12 feet wide. Asian pears comprise a large group of pears that are crisp in texture and, when mature, are good to eat as soon as harvested or for several months after picking if held in cold storage. This ready-to-eat feature may make them more acceptable to some people than European pears that are usually served when soft and juicy, which condition takes about a week to occur after removal from cold storage. Asian pears have been grown commercially in Asia for centuries. In Japan about 500,000 tons are grown and some fruit is exported to the United States in October and November. China and Korea also grow these pears for domestic consumption and export to the US

and Canada. Most new Asian pear plantings in California are in Fresno, Tulare and Kern Counties. A few plantings exist in Yakima and Wenatchee, Washington, and others are found in Hood River and Willamette Valley in Oregon. In the last few years plantings of Asian pears were made in New Zealand, Australia, Chile, France, and the eastern and southeastern United States. It is roughly estimated that 4,000 - 5,000 acres of Asian pears are planted in California, Oregon and Washington. Since 1984 about 100,000 trees (500 acres) of Asian pears have been planted every year in California. Most popular Oriental pears are 20th Century 'Nijisseiki', 'Kosui', 'Kikusui', 'Hosui', 'Shinseiki', 'Shinko', and 'Niitaki'. There are a few cultivars of hybrid origin. Asian pear cultivars are partially self-fruitful but better crops are set where two or more cultivars are planted together. It is suggested that every 4 to 8 rows of a single cultivar have a pollinizer row or that growers plant a block of 4 to 8 rows of a second cultivar adjacent to the first. Asian pears should be planted in deep, well-drained soils in a location as frost-free as possible. Sites that are prone to late spring frosts or provide frost protection where late frosts are likely should be avoided. The chilling requirement of Asian pears is thought to be in the range of 900 to 1000 hours. Under California conditions the fruit must be picked before 180 days after full bloom to avoid browning during storage (Table 20). Plant trees at least 10 to 15 feet apart in either fall or early spring. Plantings for standard size trees range from 140 – 380 trees/A and for dwarf types 300 – 400 trees/A. In California the trees are pruned and trtained to be a vase shape - On young trees, a good portion of the fruit is borne at or near the tips of one - year-old shoots. As the tree matures, most of the fruit is produced on the scaffold branches. These spurs have a productive life of about 10 years. Pruning should be done to remove about 10 percent of these terminal spurs every year.

Table 20. Days from Full Bloom to Harvest for Various Asian Pear Cultivars.

Asian Pear Cultivar	Bloom Timing	Days from Bloom to Harvest	Fruit Shape or Color
Kosui	Midseason	120 - 130	Good quality.
Shinseiki	Midseason	125 - 135	Round, yellow skin one of top cultivars in California
Hosui	Midseason	135 - 145	Large, sweet, low acid, bronze-russeted skin. Ripens in August.
Nijisseiki/20th Century	Midseason	140 - 155	Round and yellow skinned. Originated in Japan.
Chojuro	Midseason	140 - 155	Fruit orange to brown and flat.
Olympic	Midseason	115 - 170	Large round golden russet skin.
Ya Li	Early	150 - 165	Green pear shaped and large. Popular in

Asian Pear Cultivar	Bloom Timing	Days from Bloom to Harvest	Fruit Shape or Color
			China.
Tsu Li	Early	150 - 165	Large football shaped green fruit.
Okusankichi	Midseason	190 – 210	Medium size with brown russet finish. Originally from Korea.

Quince:

Quinces are fruits closely related to apples and pears, but are of lesser economic importance. The plants are deciduous thorn less shrubs or small trees. Generally they are not over 20 feet high. Fruits are mostly 2 inches up in diameter, covered with pubescence. Fruit color is generally golden yellow. Fruit flesh is creamy yellow and it is rather hard with a bitter acid taste. The most common cultivars/varieties include 'Champion', 'Pineapple', 'Smyrna' and 'Van Deman'. The quince has been cultivated for over two thousand years for its edible fruit and its seed. It is also much used as a dwarfing rootstock for pears and some other fruits. Bloom to harvest in about 150 days. The fruit is harvested only by hand because the fruit is easily bruised. Fruit weight varies from 197 – 461 g. and seeds vary from 15 – 42. Yields can range from 40 – 60 t/A. Tradionally standard tree forms are spaced 3.5 – 5.5 m between rows and 2.5 – 4.5 m between trees and bushes 3 m apart with tree densities ranging from 300 – 1200 trees/ha. Cold storage conditions similar to apple and pear are used. Quinces are pruned similarly to pears. It begins to produce fruit three years after planting and orchards can remain productive for up to 45 years. Succeeds in most soils but prefers a light moist fertile soil and a sunny position. Succeeds in semi-shade but does not fruit well in such a position. Plants are hardy to about -15 ° C, though the fruit seldom ripens in the north of Britain unless it is grown against a sunny wall. The plants require warm summers in order to fully ripen their fruit.

Quince, Chinese and Quince, Japanese:

Chinese quinces are native to China, Indo-China, and are also cultivated in Japan. Chinese quince was introduced to Europe in 1796 and Japanese quince in 1869. It is hardy to plant hardiness zone 5 and is not frost tender. It is in flower from February to June, and the seeds ripen in August through October. The flowers are hermaphrodite (has both male and female organs) and are pollinated by bees. It is noted for attracting wildlife. The bright yellow fruit can be apple or pear-shaped and up to 6.5 cm long x 6.5 cm wide and be as large as 17 cm long and 8 cm broad and weigh 180 – 600 g. It is a very ornamental plant and is considered a good bee plant, flowering early in the year and providing pollen and nectar, and can range in height from 10 - 20 ft tall and 5 – 10 ft width. It is easily cultivated as a small tree in any reasonably good soil. It prefers a deep

moist well-drained loam, and grows well in heavy clay soils. Tolerates full shade but requires a sunny position for best fruit production. This species is hardy to about -25°C. It can be propagated by seed best sown as soon as it is ripe (in February) in a sheltered position outdoors or in a cold frame. Germination usually takes place within 6 weeks. Prick out the seedlings into individual pots as soon as they are large enough to handle. If well grown, these seedlings can be large enough to plant out in the summer. Or plant them out in late spring of the following year. Cuttings of half-ripe wood are made in July/August or cuttings of mature wood of the current year's growth in November in a cold frame and layering in done in late spring or in autumn. The Japanese quince is a closely related species and had some medicinal uses in China and Japan and occurs in central and south Japan. It can grow 0.6 – 1.2 m tall and 5 m wide. It has been planted in Latvia in the 1970's and in 1996 approximately 300 ha had an average yield of 12 – 15 T/ha. A maximum yield of 20 - 30 t/ha is possible. Commercial production is also in Belarus, Finland, Germany, and Poland. The yellow (red or yellow-green) apple shaped fruit is $\leq$15 cm long and 8 cm diameter and weight can be less than 50 g and contain up to 80 seeds. Chinese quince can have up to 120 seeds. Both of these quinces are also grown for ornamental purposes.

Tejocote

Tejocote is native to the Americas and it is hardy to zone 7 and is not frost tender. The flowers are hermaphrodite (has both male and female organs) and are pollinated by midges. The plant prefers light (sandy), medium (loamy) and heavy (clay) soils and can grow in heavy clay soil. The plant prefers acid, neutral and basic (alkaline) soils. It can grow in semi-shade (light woodland) or no shade. It requires moist or wet soil and can tolerate drought. The plant can tolerate strong winds but not maritime exposure. It can tolerate atmospheric pollution. It is grown from seed. Seed will germinate in the spring, though most will probably take another year. The tejocote prefers well-drained moisture retentive loamy soil. Once established, it succeeds in excessively moist soils and also tolerates drought. Full sun is best when plants are being grown for their fruit. Seedling trees take from 5 - 8 years before they start bearing fruit, though grafted trees will often flower heavily in their third year.

Worker Activities (Adapted from USDA Apple and Pear Crop Timelines, AK, ID, MI, New England, NJ, NC, WV).

Pruning:

Virtually all apple trees are pruned by hand during the dormant season. Most apples trees are thinned with chemical applications, but approximately 75% of the apple acres have follow-up hand thinning in March and April after chemical thinning (AK). Nearly all of Michigan's apple orchards require some thinning of fruit to ensure a marketable product at harvest time. Much of this thinning is done chemically, but there

is a need to do some of the thinning work by hand. Hand thinning is primarily done from the middle of June until the first of August in Michigan, but some growers will hand thin all the way up to harvest if it is deemed necessary to ensure fruit size and quality. A worker will typically work 8 to 10 hours doing hand-thinning work per day with the majority of work being done in the early summer. It would be typical for a worker to do 10 to 14 days of hand thinning work per season. Limbs are manipulated via tying to wire trellis systems or posts inserted next to the trees or through the use of spreaders (wooden or plastic pieces inserted between the limb and the trunk of the tree). This activity is usually done when branches are supple (May - August). Workers tie or spread branches with 2 to 5 ties/spreaders per tree and work an average day. Branch manipulation is typically done after the spring apple scab season sprays are completed and between necessary internal feeder sprays.

In the New England States, pruning is used to maintain a balance between vegetative growth and fruit production that allows for adequate penetration of sunlight, chemical treatments, and air flow. Most orchards are pruned once during each winter dormant season, and usually don't begin until 3 or 4 months from the previous season's final pesticide application. Summer pruning, undertaken in late July and early August, is less extensive and focuses primarily on unproductive vegetative sprouts blocking light from ripening fruit. Summer pruning involves extensive contact with foliage. Wearing protective clothing can be problematic in summer heat, and heat stroke risk poses more immediate and severe health concerns than pesticide exposure. While there is usually some flexibility for timing summer pesticide sprays, prolonged REIs such as the 4 day REI for captan create scheduling problems for summer pruning which must be done within a time window of a few weeks.

A number of worker activities occur throughout the year that may affect application timing, as well as the specific pesticides used. In New Jersey, manual pruning is done during the dormant season, usually from late November through the middle of February. No pesticides are applied during that time. Although hand thinning can be done at any time after June, because of labor costs it is rarely a commercial practice. Therefore, fruit thinning is usually done with plant growth regulators through normal spraying practices in late May.

Growers use pruning to remove dead and damaged wood, develop and maintain tree structure and to maintain a balance between vegetative growth and fruit production. Most orchards are pruned once during each winter dormant season and may be also pruned during the growing season. Dormant pruning usually does not begin until several months after the previous season's final pesticide application. Summer pruning on producing trees, undertaken in late June and July, is less extensive and focuses primarily on removing current seasons' growth, which is shading the developing fruit. Summer pruning can involve extensive contact with foliage. Wearing protective clothing can be problematic in summer heat, and heat stroke risk poses more immediate and severe health concerns than pesticide exposure. However, using long-handled pruners may minimize the amount of worker contact with foliage. While there is usually some flexibility for timing summer pesticide sprays, prolonged reentry intervals (REIs) such as the 4-day REI

for captan create scheduling problems for summer pruning which must be done within a limited time frame. Thinning timing is critical for effective thinning and the effective window is often a matter of days. Chemical thinning agents applied with the air blast sprayer often require follow-up hand thinning and visual crop inspection requiring worker access to the orchard and extensive contact with foliage. Unfortunately, thinning is concurrent with the timing for important pesticide applications for apple scab, plum curculio, leafminers and other key pests. Long REIs on thinning agents, insecticides, or fungicides needed at this time create a major obstacle to effective and profitable crop management and raises the pesticide exposure risk factor. Carbaryl is one of the primary thinners used in apple orchards in North Carolina.

In Washington State, trees are pruned throughout the winter, while they are dormant. The orchards may be pruned any time the weather is reasonable for the pruning crews' comfort. This operation is always complete prior to the application of dormant sprays. This activity is one of the most labor intensive and expensive aspects of fruit production, as trees are not uniform, and must be pruned according to horticultural concepts. Proper pruning maintains fruit quality and production over the lifetime of the orchard, and is considered the key horticultural practice.

In Idaho, trees are pruned in the winter, while they are dormant. This operation is usually completed prior to the application of dormant sprays. If not thinned yearly, most apple cultivars will develop an alternate bearing habit, producing a heavy crop one year, then almost no crop the next. Biennial bearing can be reduced if a substantial number of blossoms and small fruit are removed from the spurs on the tree during bloom, or within two to three weeks after petal fall. Hand thinning is then done to remove additional fruit to achieve the desired crop load. Thinning the fruit by hand six to eight weeks after bloom is a very common practice. Because it is usually done after most flower bud initiation has occurred, it does little to ensure return bloom.

European pears are harvested when "firm mature"; flesh firmness is the most reliable indicator of pear maturity. Firmness in the range of 10 - 15 lbs as measured by a pressure tester is desirable for most cultivars. Pears for are picked by hand several times over a 10 - 20 day period

Sucker Control:

About half the apple orchards in Michigan have workers in the orchard from late June through July to remove suckers (waterspouts) arising from the larger limbs of the tree. This activity involves close contact with the foliage and a worker will typically work a full day at a time (8 to 10 hours per day). For the root suckers that sometimes arise from the base of the tree trunk, some growers use a contact herbicide in the row and do this task chemically. Not all apple rootstocks produce root suckers so this activity is only done in about 30 % of the orchards. A few orchardists may send a work crew through with loppers to cut off root suckers, but this is an expensive alternative and typically avoided. The grower or a family member does most of the spraying. An

average 7 day interval between sprays is typical for apple pest management programs with the majority (75 %) of pesticide application being made in late April through mid June for apple scab prevention. Sprays to trees are mostly applied with ground equipment (air blast or tower sprayers). Herbicide applications are made with low volume sprayers. Typically there is an enclosed cab tractor dedicated to pesticide applications. Training is the selection and development of a branching pattern on young apple trees so as to maximize the structure and production of high quality fruit. It is done early in the season on new plantings and mature trees.

In West Virginia, workers spend about two weeks in June hand thinning fruit and removing watersports on approximately 50 % of the apple acreage. Summer pruning is conducted for about two weeks in July on approximately 10 % of the acreage.

Weed Control:

Preemergent herbicide applications are applied in early spring, primarily with tractor mounted spray equipment. Postemergence herbicide applications are made in early summer and occasionally after harvest primarily with tractor mounted sprayers although backpack sprayers are occasionally used (30% of Arkansas apple acres). Row middles are mowed throughout the growing season. Herbicides are applied in mid April to early May in New Jersey, but may be spot applied with a hand or backpack sprayer during June or July, depending on the weed species being controlled. Mechanical cultivation may be rarely carried out 2 to 3 times a season during early May through June. Mechanical and hand cultivation is more common in blocks of newly planted non-bearing trees that are not yet under a complete spray program. Well managed orchards usually have grass or mixed vegetation aisles that are mowed at 10 day to 2 week intervals throughout the growing season.

Mowing is a standard orchard practice. Mowing is done four to six times per growing season depending on need. Mowing involves very little contact with treated bark and foliage as mowing equipment operators are riding on tractors, which may have enclosed cabs. There is potential for operators in an open cab to brush against overhanging foliage. Pesticide exposure is minimal. Fertilizer applications consist of ground applications of dry granular fertilizer for nutrients and lime. Foliar spray applications of micronutrients may be used to provide apple trees with nutrients not provided adequately in soil applications. Most soil applications are typically made late in the dormant season and foliar applications may continue throughout the growing season depending on the element and results of foliar and soil assay analysis. Distribution of ground-applied materials involves very little contact with treated bark and foliage as equipment operators are riding on tractors and pesticide exposure is minimal. Foliar applications are typically made in combination with pesticide sprays where proper worker protection measures should be in place to limit pesticide exposure. Orchard mowing in West Virginia for weed control is conducted every 3 - 4 weeks from April through August.

Pest Control:

Insecticides and fungicides are applied from early spring up to harvest primarily with orchard blast sprayers. White plastic tree guards are typically used on every tree to protect from the gnawing of mice and rabbits in the winter months. These are usually applied soon after planting. Newly established orchards receive little to no pesticide applications the first year of planting. Mulches are often applied in the spring to the base of the trees along the length of the rows. Depending on the thickness of the mulch and available labor, the mulch is pulled back away from the tree trunks in the fall to prevent rodent damage. Both the laying down and the pulling away of mulches would require workers to be in orchards for an average workday. In MI, orchard floors are routinely mowed 2 or 3 times per season to reduce pest levels such as weeds and insects and to make the orchard conditions more favorable for workers to walk through for required activities. Mowing is done with a tractor and attached mowing implement and requires very little contact with the orchard at all. Enclosed or non-enclosed cab tractors are typically used. In New England, new plantings receive few pesticide sprays, so there are no major pesticide Reentry intervals (REI) issues. Mature tree training is done at a time of year when trees typically receive little pesticide exposures for conducting summer pruning and harvest operations efficiently, and discouraging insect borers, voles and other pests. Fertilization consists of ground applications of dry fertilizer for macro nutrients and lime, and foliar spray applications of micronutrients such as boron and magnesium to provide apple trees with replacement nutrients for those lost to harvested crops. Applications may begin late in the dormant season and may continue throughout the growing season depending on the element. Distribution of ground applied materials involves very little contact with treated bark and foliage as equipment operators are riding on the machines. Pesticide exposure is minimal. Foliar applications are typically made in combination with pesticide sprays where proper worker protection measures should be in place to limit pesticide exposure. Thinning timing is critical for effective thinning and the available window is often a matter of days. Unfortunately, thinning is concurrent with timing for important pesticide applications for apple scab, European apple sawfly, plum curculio, leafminers and other key pests.

Apple pollination (Adapted from Gaus, 2002 and Warmund, 2007).

Almost all cultivars of apples require cross-pollinated by honey bees or wind with another apple or crabapple cultivar. To attain the best fruit set on apple trees, the king blossom (the largest and first one to open) in the flower cluster must be pollinated. The bloom periods of the pollinizer and the king blossom of the apple tree must overlap. Two dwarf apple cultivars with similar bloom periods should be spaced less than 20 feet apart to ensure the transfer of pollen between trees. Typical apple and crabapple bloom periods are shown in (Figure 2). The shaded area represents the bloom time. Apple cultivars that are suitable pollinators for other cultivars are shown in Figure 3.

Figure 2 Shows the Bloom Period of Apple and Crabapple Cultivars.

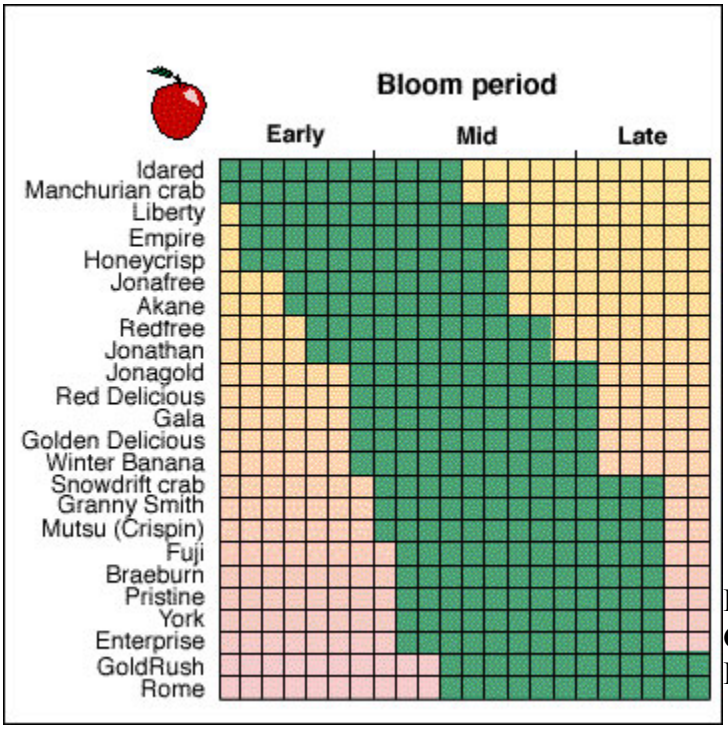
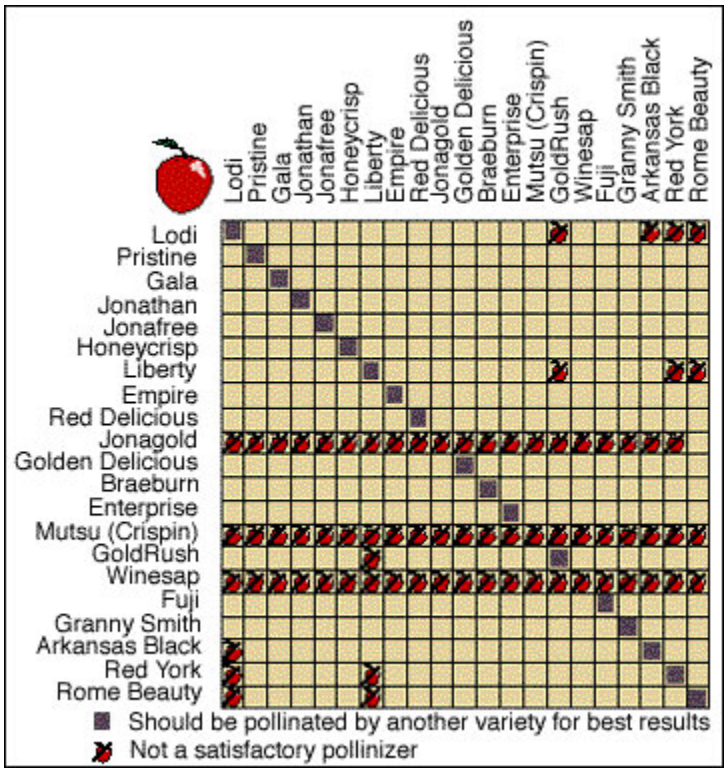


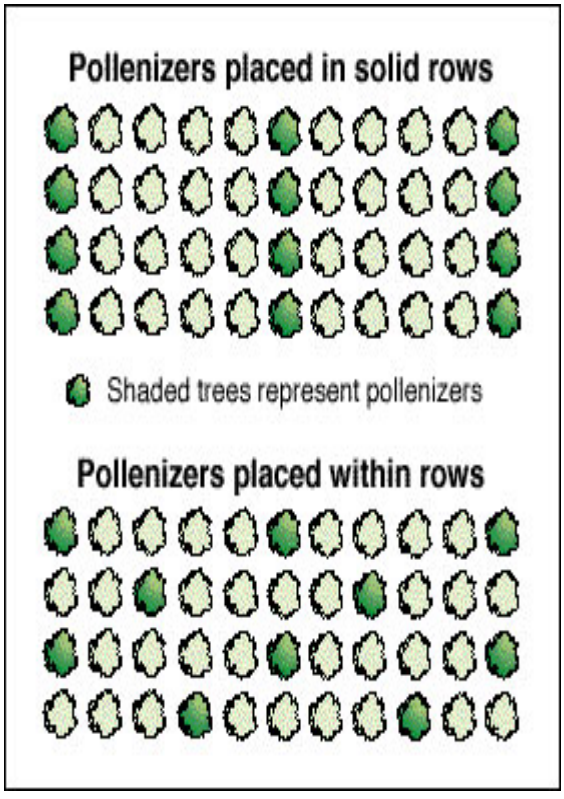
Figure 3 Shows the Apple Cultivars and Cultivars that are Suitable as Pollinizers.



Although some apple varieties, such as ‘Lodi’, ‘Liberty’, ‘Empire’, ‘Winesap’, ‘Jonathan’, ‘Jonagold’, ‘Gala’, ‘Golden Delicious’, ‘Rome’ and ‘Granny Smith’ may be listed as self-fruitful, they will set more fruit on an annual basis if they are cross-pollinated and which cultivars can be used to pollinize others (Figures 2 and 3). Some apple varieties, such as ‘Winesap’, ‘Stayman’, ‘Mutsu’ and ‘Jonagold’, produce sterile pollen and therefore cannot be used to pollinate other apple varieties. Many nursery catalogues include pollinization compatibility charts or recommend good apple varieties to use as pollinizers. Manchurian crabapple, with profuse white flowers, is commonly used to pollinate early- to mid-blooming apple varieties, while Snowdrift crabapple is used for mid- to late-blooming apple varieties (Figure 2).

In commercial apple plantings, a row of pollinizer trees is often planted between every four rows of the main variety of trees (Figure 4). If pollinizers are placed within the row, every fifth semidwarf tree is a pollinizer and each pollinizer is offset in adjacent rows to stagger them throughout the orchard block. In high-density plantings of dwarf trees (5 to 6 feet between trees within the row), apple or crabapple pollinizers may be planted between eight to ten trees of another variety in the row. Flowering crabapples are useful as pollinizers because they take up less space than a regular apple variety and may be pruned to grow in an upright position.

Figure 4. Alternative Planting Plans to Ensure Cross-pollination of Apple Trees.



Beehives are generally placed in commercial apple orchards as the king flowers open. If hives are brought in before this time, bees may forage flowers of other broad-leaved plants instead of the apple blossoms. For this reason, dandelion flowers should be removed by mowing or by herbicide treatment before hives are placed in the orchard. In orchards where semidwarf trees are planted, one hive of a medium-strength colony (15,000 to 20,000 bees) is generally sufficient per acre. Two hives per acre are used in high- density orchards where dwarf apple trees are planted. Extra strong colonies of as many as 50,000 bees have been effective in pollinating four acres of semidwarf trees under ideal climatic conditions. Pollination management is an important component of apple culture. Before planting, it is important to arrange for pollenizers - varieties of apple or crabapple that provide plentiful, viable and compatible pollen. Orchard blocks may alternate rows of compatible varieties, or may plant crabapple trees, or graft on limbs of crabapple. Growers with old orchard blocks of single varieties sometimes provide bouquets of crabapple blossoms in drums or pails in the orchard for pollenizers. During the bloom each season, apple growers usually provide pollinators to carry the pollen. Honeybee hives are most commonly used, and arrangements may be made with a commercial beekeeper who supplies hives for a fee. Standard size apple trees need one beehive/A for optimum pollination, while semi-dwarf varieties need two beehives/A, and dwarf need three beehives/A.

Symptom of inadequate pollination are small and misshapen apples, and slowness to ripen. The seeds can be counted to evaluate pollination. Well-pollinated apples are the best quality, and will have seven to ten seeds. Apples with fewer than three seeds will usually not mature and will drop from the trees in the early summer. Inadequate pollination can result from either a lack of pollinators or pollenizers, or from poor pollinating weather at bloom time.

Pear Pollination:

Most pear cultivars are commercially self-unfruitful, and need to be pollinated to set fruit. Nearly all cultivars that bloom at the same time will serve as pollinators, and honey bees are the most effective pollinator. Pears are similar to apples, with the notable exception that pear blossoms are much less attractive to bees, due to lower sugar content than apple or contemporaneous wildflower nectar. Pear flowers produce only a small amount of nectar, which is low in sugar, so more pollinators and bees will be needed for pears than for any other pome tree fruit. Bees may abandon the pear blossoms to visit dandelions or a nearby apple orchard.

Harvesting:

The entire apple crop is hand-harvested. Hand labor activities in Michigan apples include pruning. In traditional free-standing orchards, tree pruning begins as soon as some varieties are harvested in the fall, but about ¾ of the pruning effort typically takes place after the first of December. Depending on the variety of apple, some trees are pruned in the summer months to improve light penetration to the fruit for increased fruit color. About 25% of Michigan's apple acres are summer pruned. However, the increased use of plant growth regulators is reducing the need for summer pruning. Depending on the overall size of the tree, it can take anywhere from less than a minute to nearly 30 minutes to prune an apple tree. There is sometimes a need to prune out infected plant tissue (strikes) due to infection by bacterial fire blight. Infection usually occurs in May and June and removal of strikes is done typically in June and perhaps into July depending on when the infection occurred. This activity would require an average workday of time, but the total time needed would depend on the severity of the infection and the quantity of susceptible varieties in the orchard. In MI, harvesting is done from mid-August through the first of November, with the majority of harvest taking place from mid-September to late October. Harvesting in New Jersey is done by hand, usually starting in mid August for early cultivars, and continuing through early October for late cultivars. The latest insecticide applications stop by mid September, with some fungicide use continuing until 2 to 3 weeks prior to picking. In most cases the greatest worker exposure to the foliage and fruit occurs during harvest. In North Carolina, newer cultivars there may be up to three harvests of the tree over a period of several weeks allowing the fruit on the tree to mature, size and color before harvest. Timing is critical for effective harvesting and the optimal harvest window is often a matter of days, especially for fruit destined for long-term storage. Harvest occurs after the preharvest intervals (PHIs) have been reached or exceeded. In many cases no pesticides are applied within at least 4 weeks of harvest. By following the required PHIs growers reduce the risk of pesticide exposure to their workers. In some cases growers provide gloves to workers to minimize the potential for fruit contamination by the harvesting crew. Pears for are picked by hand several times over a 10-20 day period.

COMPARISON OF HARVESTING, JUICE PROCESSING, POSTHARVEST HANDLING, RAW AGRICULTURAL COMMODITY (RAC), EDIBLE PORTIONS, AND PROCESSED FOOD ITEMS FOR THE POME FRUITS:

Harvesting and Processing Apples and Pears:

Due to the diverse and maturity dates variety of apples, harvesting occurs at different times throughout the year. Most apples in the U.S., however, are harvested in the fall (between August and October).

Before harvesting occurs, apples and pears must be tested for "maturity" to determine if they're ready to be picked. This process allows consumers to receive fresh apples of the highest quality and for processors to select only the ripest apples for apple juice and applesauce. European pears are harvested when "firm mature"; flesh firmness is the most reliable indicator of pear maturity. Firmness in the range of 10 - 15 lbs as measured by a pressure tester is desirable for most cultivars. Apples and pears that are harvested too early may taste sour or starchy, and apples harvested too late may be soft. Considerations of amount of sugar, firmness and seed are looked at prior to harvest. Skin color determine maturity, many characteristics of the apples is checked prior to picking.

Once the apples are confirmed to be "mature," they are picked (mostly by hand, although some mechanical methods have been developed). The apples are then placed in canvas bags or lined buckets inside of large bins. These apple-filled bins are picked up by a forklift, loaded onto a truck and transported to a central loading area - where apples that are bruised, cut or have insect or disease problems are immediately removed. The remaining apples are stored immediately to ensure maximum storage life. Apples that are an "off" shape or appear to have "skin blemishes" may not be ideal for the produce department - but they are perfectly suitable for processing. Similar harvesting occurs for other members of the Pome fruit group.

Processing of Apples and Pears (US Apple Association, 2008, Apple Products Research and Education Council, 2008, Ferree and Warrington, 2003):

Over 40 % of the U.S apple production is processed and 54 % is juiced. The first step in any processing procedure is handling of the raw fruit. During this most critical step, the Processed Apple Institute (PAI) recommends visual inspection of all apples by a trained inspector for "integrity and sanitary condition" and random testing for spray residues or mold. Apples not meeting processing standards should be rejected and appropriate personnel informed.

Before raw apples are processed into apple juice, cider or sauce, they are put through a handling process designed to remove external surface dirt and topical chemical residues. These apples are then water-washed before processing. This water wash is sometimes accomplished as the fruit is water flumed from receiving stations to processing lines. Alternately, fruit is transported by dry conveyers through water sprays or scrubbers before processing. Most processing lines employ both techniques.

Water used in the flumes or receiving pits is often recirculated and periodically changed or refreshed. Processors sometimes add chlorine dioxide, hypochlorite or other chlorine compound to control microbial buildup in recirculated water. Apples stay in water flumes or baths for as little as one to two minutes, or as long as 30 - 45 minutes. Most flumes accomplish apple conveyance to processing lines in less than 10 minutes.

Many processors employ high pressure fresh water sprays, sometimes at several points before the fruit enters the processing line. These sprays provide a more vigorous cleaning, and are sometimes used along with mechanical scrubbers, brushes or bristles rollers to remove surface dirt. Apples are exposed to fresh water sprays for an average of 5 - 10 seconds. Cleaning compounds are not used in water sprays.

The cleaned apples are now ready to be processed into juice. Using various methods, the juice is extracted from the apples and heat-treated (pasteurized) to kill any microorganisms that might be present. This heat treatment also helps improve the overall clarity of the apple juice. Before being placed in the appropriate container (such as bottles), the juice may be further filtered and given an additional heat treatment to assure safety.

Once processed, PAI recommends that samples representing the beginning, middle and end of each production lot be collected and stored for the product's expected distribution or shelf line. Samples should then be inspected and tested by an independent contract laboratory, and any product not meeting quality standards should be identified and handled accordingly. The standard packing line procedures are used for pear - hydrocooling, washing, culling, waxing, sorting, and packing. Quality grade is based on size and appearance of skin; greater prices are obtained for larger fruit and those with minimal surface blemishes.

Processing Studies for Apples and for Their Juice, Cider, and Sauce. (Adapted from US Apple Association, 2008, and Neil Ewing, National Food Processors Association, 1992

The required processing studies for apple are in a series of processing study protocols from the National Food Processors Association submitted to Dr. Debra Edwards US EPA, OPP, CBTS (Ewing, 1992). The procedure simulates commercial practices and discusses the processing of apple samples starting with raw unwashed apples which are also processed further into wet pomace and juice. The procedure involves using unwashed whole apples are sampled for residues. For apple juice, wash the apples through a flume/spray to remove surface dirt. Apples are peeled, cored, and sliced and ground or pressed through a screen. The juice is separated from the pomace. The juice is clarified and heated to 100 – 120° F. The filtered juice is heated to 190 °F for canning and the juice sampled for residues. If applesauce samples are needed the sliced apples are cooked with water at 212 °F for 10 minutes and the cooked apples are then pressed through a screen and reheated for canning and sampling. If data is needed on apple slices they are blanched with water at 180 – 185 °F for 1 – 2 minutes and the slices are canned with water at 170 – 180 °F and sampled after canning for residues.

Fresh apple cider or sweet apple cider is made locally by farmers with their apples that do not meet fresh standards. Cider is made by pressing apples to produce juice which is then fermented. It must be refrigerated and has a storage life of 2 – 3 weeks.

Fermented or hard cider is a shelf stable product that is fermented to increase its alcohol content. Cider apples are distinct cultivars and are chosen for their fruit qualities. The cultivars are classified into four groups based on sweetness, tannin content and acidity. Tannin content is desired in cider apples which gives apples their bitter and astringent taste. Some of the apple cider cultivars are: bitter sweet – 'Ashton bitter', 'Osier', and 'White Norman; sharp' – 'Crimson king,' 'Federick', and 'Tom putt; sweet,' – 'Court royal', 'Labret', and 'Sweet coppin'; and 'Bitter sharp – Foxwelp', 'Genet Moyle', and 'Stoke red'.

Apple sauce is produced by peeling and coring apples and then slicing them into pieces and precooked usually by pressing through a pressurized steam tunnel for 4 – 5 minutes until the temperature reaches 96°C. After cooking it is passed through a finishing machine to remove any coarse materials. U.S. applesauce standards are based on color, consistency, absence of defects, flavor, and finish. Apple butter and slices are considered specialty items and are less than 1% of total apple products. Yields of apple slices vary from 45 (2 1/2 in) 64 mm apples to produce 10 lb of slices, while only 26 (3 inch) 76 mm apples make 10 lb of slices.

Comparison of the Raw Agricultural Commodities (RAC) and Processed Commodities for the Pome Fruits (see Table 21).

The raw agricultural commodities (RAC) for the Pome fruit group are similar (Table 21). Only apple requires the processed commodity for juice and the only livestock feed commodity for wet apple pomace.

Table 21. Pome Fruit Portion Analyzed for the Raw Agricultural Commodity (RAC) and the Processed Commodity (40 CFR Vol. 58, No. 187, 9/29/1993, pp. 50888 – 50893. Portion of Food Commodities Analyzed Pesticide Residues: Proposed Rule), and Table 1 Raw Agricultural and Processed Commodities Derived from Crops (EPA Residue Chemistry Guidelines OPPTS 860.1000).

Commodity	Portion Analyzed (RAC), Use as a Feedstuff (F)	Processed Commodity and Use as a Feedstuff (F)
Pome fruit group	Analyze the whole commodity after removing and discarding stems.	See apple.
Apple	Analyze the whole commodity after removing and discarding stems.	Wet pomace (F) Juice
Pear	Analyze the whole commodity after removing and discarding stems.	-
Crabapple	Analyze the whole commodity after removing and discarding stems.	-

Other uses for the specific pome fruit commodities are discussed under the section of this report for the preparation, cooking methods, uses, and marketing standards for members of the Pome fruit group 11.

LIVESTOCK FEED ITEMS:

Wet apple pomace is the only significant animal feed items associated with the Pome fruit crop group 11 (Table 21). It is used as a source of carbohydrate concentrate and fed up to 10 % of the dairy cow diet. The wet apple pomace is a byproduct of the apple processing industry, and is the processed item which remains after cider has been expressed from small whole apples, and the stems, cores, and peelings remaining after preparation of apple juice and sauce for human consumption. It is produced only in apple growing/processing areas, usually fall until mid-spring. Some is fed to growing beef, beef cows, and lactating and non-lactating dairy cows as available, but the supply is limited and it is not hauled any long distance because of shipping costs.

CROP ROTATIONS FOR THE POME FRUITS:

The members of the Pome fruit group are not rotated because of their long productive life spans at the same location most pome fruit orchards are kept at the same location for at least 25 years. Dwarf apple orchards are productive for 10 years, while semi-dwarf cultivars for $\leq$ 25 years and standard size cultivars for $\geq$ 25 years, and orchards are replanted in the same area. The growth and development of pome fruit trees including size, years to a maturity, and yield/tree are shown in Table 22. For apples the yield/tree for a semi- dwarf ranges form 5 – 10 bu/tree, while the standard size is 10 - 25 bu/tree. The standard European pear bears one – two bushels more than dwarf varieties/tree.

Table 22. Growth and Development of Pome Fruit Trees Including Years to Bear First Fruit after Planting and Yield/Tree. (Adapted from Magness, 1941, Ferree, 2003).

Fruit and Rootstock Type	Mature Height (ft)	Mature Spread (ft)	Years to Bear After Planting	Yield/Tree (Bu/Growing Season)	Bearing Season in U.S.
Apple –					
Dwarf	6 – 10	8 – 10	2 – 3	3 – 5	June – Nov.
Semi-dwarf	10 – 14	14 – 18	4 – 5	5 – 10	June – Nov
Standard	15 - 30	20 - 25	5 - 7	10 - 25	June – Nov

Fruit and Rootstock Type	Mature Height (ft)	Mature Spread (ft)	Years to Bear After Planting	Yield/Tree (Bu/Growing Season)	Bearing Season in U.S.
Pear (European)					
– Dwarf	10 – 15	10 – 12	3 – 4	1 – 3	Aug – Oct
Standard	25 - 40	20 – 25	5 - 7	3 - 4	Aug - Oct
Pear, Asian					
Standard	8 - 16	12 - 16	3 - 4	5 - 6	Aug - Oct

PEST PROBLEMS FOR THE POME FRUIT CROPS: (Developed from USDA Crop Profiles from CA, CT, ME, MA, NH, NY, OR, RI, VT, and New England (NE) Extension Bulletins, Fajardo 2006a, and Research Literature).

There are several common pest problems that occur among the pome fruits. The most important pest problems associated with this group of commodities are plant diseases including postharvest diseases, as well as some insects and mites. The following are the list of important insects, mite, diseases, weeds and vertebrate pest problems of the pome fruits (USDA Crop profiles 2007).

Proposed pome fruit commodities that are being added to the crop group share many of the same pest problems because of their similar cultural practices and their highly desirable fruits to many pests.

The members of the Pome Fruit Crop Group share many of the same pest problems since they are all members of the same botanical family the Rosaceae. Because of the similarity in the botany, cultivars and cultural practices among these crops, they have similar pest problem. Availability of a similar set of pest control options for the Pome fruit group would be useful in promoting integrated pest management (IPM) strategies to reduce the need for multiple applications and to avoid pesticide resistance problems. Some of the pests affect the external appearance of the fruit some from damage by feeding on the leaves or buds, and some by reducing postharvest keeping qualities. Weeds can reduce tree growth by up to 50 % in young trees. The weeds also harbor insect, disease hosts and provide protection for vertebrate pests as well as compete for nutrients and moisture.

Pome fruit orchards have many weed control problems that must be controlled to ensure adequate yields and harvesting efficiencies. This pome fruit group shares a multitude of insect, disease, and nematodes. Weeds include grassy and broadleaf such as annual, biennial, and perennial weeds such as Johnsongrass, Bermudagrass, morningglory, nutsedge, quackgrass, crabgrass, Canada thistle, pigweed, poison ivy, and lambsquarter. Animal pest problems include meadow voles, deer, squirrels, ground hogs, and rabbits that often knaw at the bark and girdle the tree.

For apples insect pests include plum curculio as a serious pest; as well as apple maggot, rosy apple aphid, and codling moth (Table 23). Plant diseases include fireblight, *Gymnosporangium* rust, apple scab, bitter rot, *Phytophthora* crown collar rot, and black spot, powdery mildew, fly speck, sooty blotch, post harvest diseases such as *Botrytis* (Table 24). Insects and plant diseases cause leak loss, twig loss, tree vigor loss, flower and fruit loss, tree death, and yield losses. Apples also have several nematode pests such as the dagger, root knot, and root lesion nematode. Vertebrate problems include mice, pocket gophers, rabbits, raccoons, ground hogs, and deer that knaw at the roots, foliage or twigs, and girdle trunks.

Table 23. Apple Insect Pests:

Insect Pests	AR	CA	DE	ID	KY	MI	MO	NC	NJ	NY	OH	OR	TN	VA	WA	WV	NE*
Apple maggot			X				X	X	X	X	X			X			
Fruit Worms such as																	
Green Fruitworm	X	X	X		X				X	X		X		X	X		
Japanese beetle					X	X	X	X			X						
European apple sawfly									X					X		X	
Borers		X						X									X
Apple bark borer														X			
European corn borer										X							X
Pacific flathead borer		X						X									X
Dogwood borer						X		X	X					X		X	X
Pironus borer														X			
Moths such as																	
Codling moth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Oriental fruit fly	X		X			X		X	X	X			X			X	
Gypsy moth													X				
European red mite	X	X	X	X	X	X	X	X			X						
Two spotted spider mite	X	X	X	X	X	X			X	X				X	X		X
Rust mite		X				X			X	X							
Aphids such as																	
Rosy apple aphid	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Apple aphid	X		X					X	X	X							X
Woolly apple aphid	X	X	X					X						X	X		
Green apple	X			X	X	X	X										

Insect Pests	AR	CA	DE	ID	KY	MI	MO	NC	NJ	NY	OH	OR	TN	VA	WA	WV	NE*
aphid																	
Plant Stinkbugs	X							X									
Stinkbugs								X				X				X	
Lygus bug		X		X								X				X	
Tarnished plant bug	X				X	X	X			X	X			X			X
Leafminers such as																	
Spot tentiform leafminer	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X
Leafhoppers such as																	
White apple leafhopper	X	X	X	X		X		X	X	X	X		X	X	X	X	X
Potato leafhopper						X		X		X				X			
Plum curculio	X		X		X	X	X	X	X	X	X		X	X		X	X
Scales such as																	
San Jose Scale	X		X		X	X	X	X	X	X	X		X	X		X	X
Oblique banded leafroller		X		X	X	X	X			X	X		X	X		X	X
Redbanded leafroller			X		X		X	X	X	X	X			X		X	X
Tufted apple budworm			X			X		X	X		X			X		X	
Variegated leafroller			X						X	X	X			X		X	
Worms such as																	
Fall webworm		X														X	
Lesser appleworm								X						X	X		X

Table 24. Apple Plant Disease, Nematode, and Vertebrate Pests.

Disease/ Nematode/ Vertebrate/ Pests	AR	CA	DE	ID	KY	MI	MO	NC	NY	OH	OR	TN	VA	WA	WV	NE*
Scab	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Powdery mildew	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fire blight	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black rot	X		X		X			X	X	X		X	X		X	X
White rot	X		X		X	X	X	X	X	X		X	X		X	
Bitter rot	X		X	X		X	X	X	X	X			X		X	X
Phytophthora crown collar	X	X			X	X	X	X	X	X	X		X	X	X	X

Disease/ Nematode/ Vertebrate/ Pests	AR	CA	DE	ID	KY	MI	MO	NC	NY	OH	OR	TN	VA	WA	WV	NE*
and root rot																
Sooty blotch	X		X		X	X	X	X	X	X		X	X		X	X
Alternaria blotch	X							X				X	X		X	
Cedar apple rust	X		X		X	X	X	X	X	X		X	X		X	X
Crown gall		X														
Nematodes such as																
Dagger nematode		X				X					X					X
Root knot nematode		X				X							X			
Root lesion nematode		X									X		X			
Vertebrates such as																
Voles, mice	X		X	X	X			X					X			
Pocket gopher		X												X		
Rabbits		X	X		X								X			
Deer		X	X	X	X			X					X			
Raccoons		X														
Ground hogs		X											X			

Pear insect problems include codling moth, pear psylla, European red mite, two-spotted spider mite, Pacific spider mite, McDaniel spider mite, and leafrollers (Table 25). In California, the coddling moth is a very important pest due to a lack of effective biological control systems. Plant diseases include pear scab, *Venturia pirina*, fire blight, *Armillaria* root rot (oak root fungus), post-harvest diseases caused by fungi (gray mold caused by *Botrytis cinerea*. The more important post-harvest diseases of pears are powdery mildew, blue mold, *Alternaria* rot, and mucor rot. Nematodes include the Dagger and root lesion nematode. Vertebrate problems are similar to apples in that meadow voles will knaw at the bark and roots and can girdle the trees.

Table 25. Pear Pest Problems.

Insect/ Disease/ Nematode/ Vertebrate/ Pests	**CA**	**CT**	**MA**	**ME**	**MI**	**NH**	**NE**	**NY**	**OR**	**VT**
Insects										
Coddling moth	X				X			X	X	
Pear psylla	X				X		X		X	
Pear sawfly					X					
Plum curculio							X	X		
Tarnish plant bug							X			
Two spotted spider mite					X		X			
Rust mite					X		X	X		
Pear leaf blister mite	X				X			X		
Grape mealybug					X					
Mealybug								X		
Green fruitworm								X	X	
Pear midge							X	X		
Oblique banded leafroller	X							X		
Diseases										
Fireblight	X				X		X	X		
Leafspots					X					
Pear scab	X				X		X		X	
Armillaria root rot	X									
Nematodes										
Dagger nematode					X					
Root lesion nematode					X					
Vertebrates										
Voles, mice							X	X		

The flowering crabapples are relatively undamaged by most insects but mmajor insect pests include various types of caterpillars, leafhoppers, leaf-rollers, leafminers, and Japanese beetles, but these pests often do not cause significant damage to the trees. Plant diseases include apple scab, frog-eye leaf spot, and fire blight.

For loquats, infestations of black scale may appear, and fruit flies are serious pests in areas where they are problem. Plant diseases include fire blight caused by *Erwinia amylovora* is a major disease of loquat in California; crown rot caused by *Phytophthora* and cankers caused by *Pseudomonas eriobotrya* are also occasional problems.

For mayhaws, insect pests are similar to apples and include plum curculio, hawthorn lace bug, flower thrips, roundheaded appletree borer, whitefringed beetle, leafminers, scales and mealybugs. Plant diseases include quince rust, (*Gymnosporangium clavipes*), fireblight (*Erwinia amlovora*), and brown fruit rot (*Monilia johnsonii*).

Many diseases also infect quinces and include fireblight, rust, wilt, coddling moths, woolly aphid, and pear leaf blight. Medlars also have similar pest problems such as fireblight, rust, powdery mildew and brown rot.

COMPARISON OF POTENTIAL RESIDUE LEVELS IN THE POME FRUITS:

Magness, Markle, and Compton in 1971 classified food and feed crops based on predicting the potential for pesticide residues based on exposure of the edible parts to applied pesticides, which led to the development of the crop groups. The majority of the pome fruits (apple, pear, and quince) were classified in the Fruit Crops Category III. Category III include the pome fruit crops with fruits mostly medium to large, peel generally discarded in processing, but may be eaten with the fresh fruit. Category III fruit crops will have moderate exposure of edible parts to applied pesticides. The crabapple is placed in Fruit Crops Category IV since it has somewhat greater exposure of edible parts to pesticides than in Category III, because peel is commonly consumed or in contact with the mouth or when pressed for juice. Fruits are medium to small and the peel is commonly consumed.

We expect that all proposed members of the pome fruit crop group will have similar residue levels based on similarities of the raw agricultural commodities (RAC's), cultural practices, and pest problems. A comparison of established tolerances on pome fruit commodities also supports that residue levels will be similar between members of the crop group and subgroups (See Tables 26, 27, and 28). The proposed representative commodities cover over 99 % of the total pome fruit production in the U.S., and they also tend to be an equal or more conservative estimate of tolerances and potential residues. Based on existing tolerances in 40 CFR and the USDA FAS MRLdatabase, a comparison of these tolerances for the representative commodities is listed in Table 27 for the U.S., Codex MRL's, and the European Union (EU). In several cases the U.S. tolerances are the same or higher than those established in the EU and/or in Codex. Tables 28 contain

tolerances established in the U.S. on the representative commodities apple and pear and shows the tolerance levels are remarkably similar.

Table 26. Tolerances (ppm) Established on Pome Fruit Group 11.

Compound	U.S. Tolerance (ppm)	CFR Citation
2,4-D	0.1	180.142
Acequinocyl	0.40	180.599
Acetamiprid	1	180.578
Bifenazate	0.75	180.572
Boscalid	3	180.589
Buprofezin	4	180.511
Carbaryl	12	180.319
Carfentrazone-Ethyl	0.1	180.515
Chlorantranilprole	0.30	180.628
Clothianidin	1	180.586
Cyfluthrin	0.5	180.436
Cypermethrin	2	180.418
Cyprodinil	0.1	180.532
Deltamethrin	0.2	180.435
Dicofol	10.0	180.163
Difenoconazole	1.0	180.475
Diquat	0.02	180.226
Dithianon	5	180.621
Emamectin	0.025	180.506
Etoxazole	0.2	180.593
Fenpropathrin	5.0	180.466
Fenpyroximate	0.4	180.566
Flonicamid	0.2	180.613
Fludioxonil	5.0	180.516
Flumioxazin	0.02	180.568
Fluroxypr 1-methylheptyl ester	0.02	180.535
Glyphosate	0.2	180.364
Hexythiazox	1.7	180.448
Imidacloprid	0.6	180.472
Lambda Cyhalothrin	0.3	180.438
Methidathion	0.05	180.298
Methoxyfenozide	1.5	180.544
Napropamide	0.1	180.328
Novaluron	2	180.598
Oryzalin	0.05	180.304
Oxyfluorfen	0.05	180.381
Paraquat	0.05	180.205
Pendimethalin	0.10	180.361
Permethrin	0.10	180.378
Prohexadione calcium	3.0	180.547
Pyraclostrobin	1.5	180.582
Pyrimethanil	3.0	180.518
Pyriproxyfen	0.2	180.510
Rimsulfuron	0.01	180.478
Sethoxydim	0.2	180.412
Spinetoram	0.20	180.635

Compound	U.S. Tolerance (ppm)	CFR Citation
Spinosad	0.20	180.495
Spirodiclofen	0.8	180.608
Streptomycin	0.25	180.245
Tebufenozide	1.5	180.482
Thiabendazole	5.0	180.242
Thiacloprid	0.3	180.594
Thiamethoxam	0.2	180.565

Table 27. Tolerances (ppm) Established Internationally on Pome Fruits.
(FASONLINE; FAJARDO 2006a; O'TOOLE 2006a; DUGGAN 2006c)

Compound	US	Codex	EU
2,4-D	0.1	0.01	0.05
Abamectin	–	–	0.01
Acephate	–	–	0.02
Acequinocyl	0.40	–	–
Acetamiprid	1	–	–
Aldicarb	–	–	0.05
Amitraz	–	0.5	0.05
Atrazine	–	–	0.1
Azinphos-methyl	–	1	0.5
Azoxystrobin	–	–	0.05
Benomyl	–	–	0.2
Bentazon	–	–	0.1
Bifenazate	0.75	–	–
Bifenthrin	–	–	0.3
Boscalid	3	–	–
Bromoxynil	–	–	0.05
Buprofezin	4	–	–
Captafol	–	–	0.02
Captan	–	–	0.1
Carbaryl	12	–	0.05
Carbofuran	–	–	0.02
Carfentrazone-Ethyl	0.1	–	0.01
Chlorfenapyr	–	–	0.05
Chlorantranilprole	0.30	-	0.30
Chlorothalonil	–	–	1
Chlorpropham	–	–	0.05
Chlorpyrifos	–	1.0	0.5
Clofentezine	–	0.5	0.5
Clothianidin	1	–	–
Cyfluthrin	0.5	–	0.2
Cypermethrin	2	2	1
Cyprodinil	0.1	–	–
Cyromazine	–	–	0.05
Deltamethrin	0.2	–	–
Diazinon	–	0.3	0.02
Dichlorvos	–	–	0.01
Dicofol	10.0	–	0.022
Difenoconazole	1.0	0.5	0.5
Diflubenzuron	–	5	–
Dimethoate	–	–	0.02
Diphenylamine	–	–	0.05
Diquat	0.02	–	0.05

Compound	US	Codex	EU
Disulfoton	–	–	0.02
Dithianon	5	-	-
Dodine	–	–	1
Emamectin	0.025	–	–
Endosulfan	–	1	0.3
Esfenvalerate	–	–	0.05
Ethephon	–	–	3
Ethofumesate	–	–	0.05
Ethylene Oxide	–	–	0.1
Etoxazole	0.2	–	–
Fenamidone	–	–	0.02
Fenamiphos	–	–	0.02
Fenarimol	–	0.3	0.3
Fenbutatin-Oxide	–	5	2
Fenpropathrin	5	5	0.01
Fenpyroximate	0.4	–	–
Fentin Hydroxide	–	–	0.05
Fenvalerate	–	2	0.02
Ferbam	–	5	–
Flonicamid	0.2	–	–
Fludioxonil	5	–	–
Flumioxazin	0.02	–	–
Fluroxypyr 1-methylheptyl ester	0.02	-	0.05
Folpet	–	–	0.01
Fosetyl-Al	10	–	–
Fosthiazate	–	–	0.02
Gamma Cyhalothrin	0.3	0.2	–
Glufosinate-Ammonium	–	0.05	–
Glyphosate	0.2	–	0.1
Hexythiazox	1.7	0.5	1.0
Imazalil	–	5	5
Imidacloprid	0.6	–	–
Inorganic bromide resulting from fumigation	–	30	0.05
Inorganic bromide resulting from soil treatment	–	–	0.05
Iprodione	–	5	5
Kresoxim-Methyl	0.5	0.2	0.2
Lambda Cyhalothrin	0.3	0.2	0.1
Malathion	–	–	0.5
Maleic Hydrazide	–	–	0.2
Mancozeb	–	5	3
Maneb	–	5	3
Mesotrione	–	–	0.05
Metalaxyl	–	1	1
Methamidophos	–	–	0.05
Methidathion	0.05	0.5	0.2
Methomyl	–	2	0.2
Methoxyfenozide	1.5	–	–
Methyl bromide[2]	5.0	–	–
Metiram	–	–	3
Metsulfuron-Methyl	–	–	0.05
Mevinphos	–	–	0.2
Myclobutanil	–	0.5	0.5
Napropamide	0.1	–	–

[2] For post-harvest fumigation treatment.

Compound	US	Codex	EU
Novaluron	2	–	–
O-phenylphenol	10	10	–
Oryzalin	0.05	–	–
Oxydemeton-Methyl	–	–	0.02
Oxyfluorfen	0.05	–	–
Paraquat	0.05	–	0.05
Pendimethalin	0.10	-	0.05
Permethrin	0.10	2	0.05
Phorate	–	–	0.05
Phosalone	–	2.0	2
Procymidone	–	–	0.02
Prohexadione calcium	3.0	–	0.05
Propiconazole	–	–	0.05
Propyzamide	–	–	0.02
Pymetrozine	–	–	0.02
Pyraclostrobin	1.5	–	0.02
Pyrethrins	–	–	1
Pyridate	–	–	0.05
Pyrimethanil	3	7	5
Pyriproxyfen	0.2	–	–
Quinoxyfen	–	–	0.02[1]
Rimsulfuron	0.01	-	0.05
Sethoxydim	0.2	–	0.1
Spinetoram	0.20	-	0.2
Spinosad	0.2	–	1.0
Spirodiclofen	0.8	–	0.8
Streptomycin	0.25	–	–
Sulfosate	0.05	–	–
Tebuconazole	–	0.5	–
Tebufenozide	1.5	1	–
Thiabendazole	5.0	3.0	0.05
Thiacloprid	0.3	–	–
Thiamethoxam	0.2	–	–
Thiodicarb	–	–	0.2
Thiophanate-methyl	–	–	0.5
Thiram	–	5	3
Triadimefon	–	0.5	0.1
Triadimenol	–	0.5	–
Triallate	–	–	0.1
Tridemorph	–	–	0.05
Trifloxystrobin	0.5	–	0.5
Triflumizole	2.0		
Zeta-Cypermethrin	–	2	–
Ziram	–	5	–
Zoxamide	–	–	0.02

Table 28. Tolerances Established in U.S. on Representative Pome Fruit Crops.

Compound	CFR Citation	Apple	Pear
Aminoethoxyvinylglycine hydrochloride	180.502	0.08	0.08
Avermectrin	180.449	0.02	0.02
Benomyl	180.294	7.0*	7.0*
Captan	180.103	25	25

Compound	CFR Citation	Apple	Pear
Chlorpyrifos	180.342	1.5	0.05
Clofentezine	180.446	0.5	0.5
Cyano (3-phenoxyphenyl)methyl-4-chloro-and b.alpha;-(1-methylethyl) benzeneacetate	180.379	2.0	2.0
Diazinon	180.153	0.5	0.5
Dichlobenil	180.231	0.5	0.5
Dimethoate	180.204	2	.2
Diphenylamine	180.190	10*	5.0*
Dodine	180.172	5.0	5.0
Diuron	180.106	1	1
Endosulfan	180.182	1.0	2.0
Fenarimol	180.421	0.1	0.1
Fenazaquin	180.632	0.2	0.50
Ferbam	180.114	4	4
Formetanate hydrochloride	180.276	3.0	3.0
Hexakis	180.362	15.0	15.0
Inorganic bromide	180.123	5*	5*
Malathion	180.111	8	8
Mancozeb	180.176	7	10
Methomyl	180.253	1	4
Methyl parathion	180.121	1	1
N -(Mercaptomethyl) phthalimide S -(O,O -dimethyl phosphorodithioate) and its oxygen analog	180.261	10	10
Naphthaleneacetamide	180.309	0.1	0.1
Norflurazon	180.356	0.1	0.1
O,O -Dimethyl S -[(4-oxo-1,2,3-benzotriazin-3(4 H)-yl)methyl]phosphorodithioate	180.154	1.5	1.5
O-phenylphenol	180.129	25	25
Oxamyl	180.303	2	2
Oxytetracyline	180.337	0.35	0.35
Phosalone	180.263	10.0	10.0
Piperonyl Butoxide	180.127	8*	8*
Propyzamide	180.317	0.1	0.1
Pyrethrins	180.128	1.0	1.0
Pyridaben	180.494	0.5	0.75
Simazine	180.213	0.20	0.25
Thiophanate-Methyl	180.371	2.0	3.0
Triadimefon	180.410	1.0	1.0
Trifumizole	180.476	0.5	0.5

REQUIRED NUMBER OF CROP FIELD TRIALS FOR CROP GROUP 10 AND COMPARISON OF EPA CROP PRODUCTION REGIONS WITH THE NAFTA CROP PRODUCTION REGIONS:

A reevaluation of crop production data from the 2002 USDA Agricultural Census shows that the amended Pome fruit crop group 11 will not require additional field trials because the acreage for apple and pear have not significantly changed from the 1991 data used in the current field trial guidelines (EPA OPPTS 860.1500). The suggestive current number of crop field trials for the Pome fruit group 11 is listed in Tables 29, 30, 31, and 32, respectively. The only difference in the 2002 AG Census shows a shift in apple production from 2 trials in Region 2 to one and an increase of one trial in Region 11 (Table 31 and 32). Pear field trials have not changed over this time. It should be noted the number of field trials in Table 32 is based on new AGCensus data only and will have to be assessed by an internal NAFTA workgroup for any changes in field trial regions. Table 32 is not approved by EPA or PMRA. Locations of the field trial regions where pome fruits are grown are in Table 30).

Table 29. Required Number of Field Trials for Pome Fruit Commodities to Establish a Pome Fruit Crop Group 11. (40 CFR 180.4(11), [OPPTS 860.1500, Table 2).

Representative Commodity	Number of Field Trials for Commodities if Not Part of the Crop Group	Number of Field Trials for Commodities as Part of the Crop Group
Apple	16 in current guidelines	12
Pear	8 in current guidelines	6
Total	24*	18

* Attachment 7. Methodology for Determining Number of Field Trials, in Appendix A of the EPA OPPTS 860.1500 Crop Field Trials.

Table 30. EPA Crop Production Regions for the Pome Fruit Crops. [Representative Commodities (*) for the Crop Group].

Commodity**	1	2	3	4	5	6	7	8	9	10	11	12	13
Apple*	X	X			X				X	X	X		
Azarole													X
Crabapple	X	X			X				X	X			
Loquat			X							X			X
Mayhaw		X	X	X		X							
Medlar				X									
Pear*	X				X					X	X	X	
Pear, Oriental		X								X			
Quince										X	X	X	
Quince, Chinese										X	X	X	
Quince, Japanese										X	X	X	
Tejocote						X		X					

** Commodities that are not representative commodities have field trial regions generally based on the USDA Plants Database, 2006.

Table 31. Current EPA Crop Production Regions Suggested Distribution of the Pome Fruit Crop Field Trials ≥ 3 for the Representative Commodities for the Crop Group based on Current Guidelines [OPPTS 860.1500, Table 5].

Commodity	# Field Trials	1	2	5	9	10	11	12
Apple*	16	4	2	3	1	1	5	0
Pear*	8	1	0	0	0	2	4	1

* Representative Commodities for the Crop Group.

Table 32. EPA Crop Production Regions Suggested Distribution of the Pome Fruit Crop Field Trials ≥ 3 for the Representative Commodities for the Crop Group based on Updated 2002 USDA AgCensus.

Commodity	# Field Trials	1	2	5	9	10	11	12
Apple	16	4	1	3	1	1	6	0
Pear	8	1	0	0	0	2	4	1

Currently if a crop group tolerance is not being pursued the number of field trials for the individual commodities apple and pear is 16 and 8 respectively for a total number of 24 trials (Tables 29 and 31). The number of field trials for the representative commodities if a Pome fruit group tolerance is proposed is 12 field trials for apple and six field trials for pear for a total of 18 trials (Table 29).

Efforts to update the NAFTA regions will begin in 2009. Any future conflict in testing between regions can generally be resolved by having the ChemSAC review the test protocol regions before residue trials are initiated and any differences can also be resolved by input from the International Crop Grouping Consulting Committee (ICGCC) and Canada, PMRA.

CODEX CLASSIFICATION OF PROPOSED COMMODITIES AND EPA FOOD AND FEED COMMODITY VOCABULARY: See Table 33. Comparison of Pome Fruit Crop Groups: Codex (001) and EPA (10). (Data prepared by Dr's. Yuen-Shaung NG, Hong Chen, and Dr. Bernard A. Schneider, US EPA and USDA IR-4, 2004, 2007).

Another important aspect of crop grouping is the harmonization effort with the Codex Classification of Foods and Animal Feeds. The current EPA crop group for Pome fruit group 11 is similar to the corresponding Codex Pome fruits (Crop Group 002). The Codex Group 002, Pome Fruits, consists of eleven commodities including six of the seven commodities in the current EPA crop group 8 (Table 33). The only exceptions are

mayhaw which is in the U.S. crop grouping system and medlar which is in the Codex system. The U.S. Crop group is also proposing to add five new commodities: azarole, Chinese quince, Japanese quince, medlar, and tejocote that are not yet in the Codex classification system. EPA will change the name of the commodity Oriental pear to Asian pear based on the international usage of Asian pear as a trade name for this commodity. The eleven Codex commodities really consist of seven distinct commodities with the rest being multiple entries, or varieties of cultivar of other commodities listed. The scientific name for Oriental pear in the Codex system is incorrect *Pyrus pyritolia* should be *Pyrus pyrifolia* (Burm. f.) Nakai var. *culta* (Makino) Nakai and the scientific name for pear should be *Pyrus communis* L. not *Pyrus pyrifolia.*

Note that the current Codex crop group does not have representative commodities. A revision of the Codex Classification is underway with consideration to include adding new commodities, creating subgroups, and selecting representative commodities. The IR-4/EPA Crop Grouping Working Group and the International Crop Grouping Consulting Committee (ICGCC) are making every effort to cooperate with the Codex revision effort. The proposed revised Pome Fruit Group was discussed within the ICGCC workgroup which includes representatives from the Codex Revision workgroup. The expanded Pome Fruit Group and the representative commodities proposed in this petition would facilitate the harmonization of the U.S. and the Codex crop classification systems. In the next proposed revision to the Codex Classification of Foods and Animal Feeds we would expect these changes to be considered as additions to their Pome group in the harmonization effort that Bill Barney, USDA IR - 4 is coordinating with the Codex delegation. Therefore, this proposal will not only increase harmonization with the Canadian and NAFTA crop grouping system, but it is compatible with the international system of Codex. The Food Quality Protection Act of 1996 placed increased emphasis on using Codex MRLs in setting tolerances for pesticides in the U.S.

Table 33. EPA/Codex Pome Fruit Group Comparison (Based on Ng and Schneider, 2008).

Codex Group #	Codex Commodity Name	EPA Group #	Proposed EPA Commodity Name
002	APPLE	11	APPLE
070	APPLE JUICE	11	APPLE, JUICE
071	APPLE POMACE, DRY	11	APPLE, DRIED POMACE
055	APPLES, DRIED	11	APPLE
-----	----------	11	AZAROLE
002	CRAB-APPLE	11	CRABAPPLE
002	JAPANESE MEDLAR, SEE LOQUAT	11	LOQUAT
002	LOQUAT	11	LOQUAT
-----	----------	11	MAYHAW
002	MEDLAR	--	MEDLAR
002	NASHI PEAR, SEE PEAR, ORIENTAL	11	PEAR, ORIENTAL WILL BE CHANGED TO ASIAN PEAR WHICH HAS BECOME THE

Codex Group #	Codex Commodity Name	EPA Group #	Proposed EPA Commodity Name
			INTERNATIONAL TRADE NAME FOR THIS COMMODITY
002	PEAR	11	PEAR
002	PEAR, ORIENTAL, SEE PEAR	11	PEAR, ORIENTAL WILL BE CHANGED TO ASIAN PEAR WHICH HAS BECOME THE INTERNATIONAL TRADE NAME FOR THIS COMMODITY
002	POME FRUITS	11	FRUIT, POME, GROUP 11
002	QUINCE	11	QUINCE
-----	----------	11	QUINCE, CHINESE
-----	----------	11	QUINCE, JAPANESE
002	SAND PEAR, SEE PEAR, ORIENTAL	11	PEAR, ORIENTAL WILL BE CHANGED TO ASIAN PEAR WHICH HAS BECOMES THE INTERNATIONAL TRADE NAME FOR THIS COMMODITY
-----	TEJOCOTE	11	TEJOCOTE

PREPARATION, FOOD FORMS, COOKING METHODS, FOOD FORMS, SPECIFIC USES, MEDICINAL USES, FRUIT YIELDS, AND MARKETING STANDARDS FOR MEMBERS OF THE POME FRUIT CROP GROUP:

Preparation and Cooking Methods for the Pome Fruits:

The twelve commodities in the proposed amended Pome fruit crop group are all long living perennial angiosperms (flowering plants) that are deciduous small trees that produce an edible fruit called a pome.

The members of this crop group have similar uses, and all are consumed fresh or consumed cooked or raw in various recipes including salads, jellies, and juices. They can be used fresh or in a dehydrated form. Some of these pome fruits also have medicinal properties. The fact that these pome fruits are in the same family with similar biological and cultural aspects suggests they should also encounter similar pest problems and hence have similar needs for pest control products in similar use patterns. The cooking methods and food forms used to prepare pome fruits are shown in Table 43**.** Pome fruits have many food and nonfood uses. They also have ornamental landscape uses, plant extracts for medicinal uses, and uses as dyestuffs. Specific uses for some of the Pome fruits will be discussed below.

Specific Uses of Pome Fruits:

Apple

Apples have many food uses and can be eaten fresh, eating, canned, sauce and slices, juice, dried, frozen, vinegar for culinary uses (Table 34). Parts of the plant consumed are mainly fruit flesh, but peel often eaten on fresh fruits. Peels and cores from processing plants may be used in vinegar, or as livestock feed. Pulp and peel from juice processing are used as livestock feed. Apples have a broad spectrum of food uses: pies and cakes, jams, apple sauces and juices, apple butter, dried apples, and much more. Most apples can be eaten out of hand just as they are or they can be cored, peeled and sliced first. Generally, if they are going to be cooked or used in other food dishes, the apples must be prepared in some manner and cut in many shapes and sizes, such as rings, slices, wedges, and triangles. They can also be diced, julienne and shredded. The end use of the apple will determine how it is to be cut. Larger cut pieces are often used in recipes where the apple will be cooked in some manner, while smaller pieces are used in recipes where the apple will not be cooked, such as in a salad. When fresh apples are peeled or cut open, the apple's cells are exposed and react with the oxygen in the air. The oxidation reaction that occurs is what turns the apple brown. When an apple is bruised the same type of reaction will occur. If an apple is damaged by being hit or dropped, the apple's cells in that area are damaged and exposed to the air inside the apple, causing them to turn brown. When preparing apples for use, an anti-browning solution such as ascorbic acid should be used to prevent the apples from turning brown. Apples can be cooked using many methods. They can be cooked on their own and eaten as a side dish or added with other ingredients to create a main dish. Cooked apples are used with meats, such as ham, pork, and poultry. There are many recipes and different techniques used to bake apples. The apples may be left whole, unpeeled, and cores removed, or they may have a portion peeled and skins left on the remainder. Some recipes will call for the apples to be cut in half first and then the cores removed. Generally the recipe will have some type of filling that is added to the cavity of the apple before baking. The filling may be as simple as butter and brown sugar or it may consist of a mixture of several ingredients, such as butter, sugar, brown sugar, syrup, honey, apple juice, water, cinnamon, nutmeg, dried fruit, and nuts. Apples may also be cut into rings, wedges, or slices for frying. They may also be peeled or unpeeled, depending on the recipe. Apples are generally fried in butter and either white sugar or brown sugar, which helps them keep their shape. Some recipes will call for other ingredients, such as cinnamon, nutmeg, salt, egg, and water. Applesauce is a popular food that is simple to cook and made with few ingredients. The basic ingredients consist of cooking apples, sugar and water. Other ingredients, such as cinnamon, nutmeg, cloves, lemon juice or zest, and apple cider, can be added to enhance the flavor. Drying apples will remove moisture from the apple, leaving it with a concentrated flavor. Dried apples make a sweet nutritious snack and are easy to store. They can also be reconstituted for use in sweet and savory dishes. There are several methods that can be used to dry apples. They can be sun dried, oven dried, or dried in a dehydrator. Apple juice has surpassed orange juice consumption by children in

the USA. A medium-sized apple contains about 80 calories, and is unusually high in fiber: generally about 5 grams per fruit (mostly from pectin). In 2001, United States consumers ate an average of 45.2 pounds of apples and processed apple products. About 60% are eaten fresh (about 60 - 70 apples, or more than 1 per week). The utilization is as follows: fresh is 55 - 60%; canned is 12 - 15%; dried is 2 - 3%; frozen is 2 - 3%; with juice, cider; sauce, vinegar; another 20 - 25%. The wet apple pomace can be fed to beef or dairy cattle within areas close to the processing plants. The apple wood is also used in smoking foods.

Table 34. Guidance for Selecting the Best Apple by Usage.

Variety of Apple	Fresh	Salad	Bake	Cook	Pie	Dried	Other
Baldwin			X	X			Cider
Braeburn	X	X	X	X	X		Sauce
Cameo	X	X	X		X		
Cortland	X	X	X	X	X		Sauce
Crabapple							Jelly & Wine Butter
Criterion	X	X	X		X		Sauce
Elstar	X	X	X		X		Sauce
Empire	X	X	X	X	X	X	
Fuji	X	X	X		X		Sauce
Gala	X	X	X		X	X	
Ginger Gold	X	X	X				Sauce
Golden Delicious	X	X	X	X	X		Sauce
Golden Russet	X		X			X	Cider
Golden Supreme			X			X	Cider
Granny Smith	X	X	X	X	X		Sauce
Gravenstein	X		X	X	X		Sauce
Green Pippin			X		X		Sauce
Honeycrisp	X	X	X	X	X	X	Sauce
Honeygold	X	X	X		X		Sauce
Idared	X		X	X	X	X	Sauce

Variety of Apple	Fresh	Salad	Bake	Cook	Pie	Dried	Other
Jonagold	X	X	X	X	X		Sauce
Jonamac	X		X	X			
Jonathan	X	X	X	X	X	X	Sauce
Lady	X						Sauce
Liberty	X		X	X	X		Dessert
Macoun	X		X		X		Sauce
McIntosh	X	X		X	X*		Sauce
Mutsu	X		X	X	X		Sauce
Newton Pippin	X	X	X		X		Sauce
Northern Spy			X		X		Sauce
Northwest Greening			X	X	X		Sauce
Paula Red	X	X	X	X	X		Sauce**
Pink Lady	X	X	X		X		Sauce
Red Delicious	X	X					
Rhode Island Greening	X		X	X	X		Sauce
Rome			X	X	X		Sauce
Spartan	X	X	X		X	X	Sauce
Stayman	X	X	X	X	X		
Winesap	X	X	X		X		Sauce
York Imperial			X	X	X		Sauce
Zestar	X		X		X		Sauce

Azarole:

Azarole fruit are small fruits used as raw or cooked in pies, preserves. The fruit can be used fresh or dried for later use. In warm temperate areas the fruit develops more fruit sugars and has a fragrant sugary pulp with a slightly acid flavor. It can be eaten out of hand. In cooler zones, however, the fruit does not develop so well and is best cooked or used in preserves, jams, jellies, butters, candid fruit slices, and compotes. It is also made into a sweet wine, juice for fruit drinks and soft drinks. The fruit is very variable in size and color; it is up to 25 mm in diameter. There are up to five fairly large seeds in the

centre of the fruit, these often stick together and so the effect is of eating a cherry-like fruit with a single seed.

Crabapple:

There are varieties such as 'Hyslop' and 'Red Siberian' that produce relatively large fruit that can be used as a food crop and are processed for cinnamon apple rings. Fruit is processed and used for apple jelly, apple sauce, tarts, and apple butter. The pulp after making jelly can be fermented into cider or added to breads, cakes, and cookies. Fruit can also be used as a garnish. Crabapples trees are used for pollinators in apple orchards and as a showy ornamental crop. The Western crabapple is eaten fresh or stored under water, or under a mixture of water and oil, in cedar wood storage boxes. The fruit can be eaten raw or cooked. The whole fruit is processed in pickling and preserving. The fruit can be cooked, with core tissue and peel sieved out.

Loquat

The loquat is used fresh eating out of hand or in fruit salads, and it is also used for juice or wine or cooked for desserts, jams, jellies, pies, sauces, drinks, candid fruit, sauces or preserves. Loquat pie if made from fruit not yet ripe tastes like cherries. Only the inner pulp is consumed. Most often eaten fresh, but due to bruising, are rarely marketed this way. Loquats are also found canned in heavy syrup.

Mayhaw

Mayhaws are sorted by removing decayed fruit and trash, and wash thoroughly before food preparation. To make juice and jelly, a gallon (4 quarts or about 4 1/2 pounds) of mayhaws cooked they are covered with 3 quarts (12 cups) of water. Bring to a boil, cover and cook gently for about 30 minutes. Cool and drain juice first through a colander, pressing fruit lightly with the back of a spoon. Then strain the juice through two or three thicknesses of damp cheesecloth, or through a jelly bag or a clean thin white cloth. The sediment which settles to the bottom is discarded. One gallon (4 quarts) or about 4 1/2 pounds of mayhaws will yield about 12 cups of strained, flavorful juice, enough for three batches of jelly. It is used mainly for jellies, preserves, and also in wines and syrup. In China it is available as jelly, jam, gelatin, fruit rolls, soft drink mixes, dried slices for tea, and wine. They can be canned or frozen and used to make jelly year around.

Medlar

Medlars are used for fresh eating out of hand or used for beverage, syrups, dessert, or preserves. They can be baked whole or roasted, or made into tarts, jams and jellies, and

occasionally made into cider. The plant is often used as an ornamental. The main part consumed is the inner pulp only and the skin and seeds are discarded.

Pear

Pears are used primarily as a fresh fruit, and they are also processed as canned, dried, pickled, baked, baby food and beverages. They are also made into marmalades, preserves, fruit nectars, puree, juice, and pies, or cider. Only the inner flesh is used in canned or baby food preparations. The juice is now extensively used to add to canning of many fruits. The peel may be consumed when eaten fresh and is retained on dried fruit. The core may also be used to make vinegar.

Oriental pear

The Asian or oriental pear has similar uses to pears.

Quince

Quince is rarely eaten fresh, mostly utilized for jelly and other preserves. The pineapple quince must be cooked before using. It is primarily eaten stewed, preserves with pears, stuffed, or made into pies, marmalades, jams, jellies, liquors, wine, fruit leather, conserves, and candy. The flowering quince is widely grown as an ornamental, often sets some fruit that also may be utilized for jelly. When grown in warm temperate or tropical climates, the fruit can become soft and juicy and is suitable for eating raw. Internal flesh, but all cooked prior to pressing for jelly. The flowers are also edible. In cooler climates such as Britain, however, it remains hard and astringent and needs to be cooked before being eaten.

Quince, Chinese and Quince, Japanese:

The fruit is cooked or parboiled, mashed after seeds are removed, and then mixed with a honey and ginger to make a beverage. It is harsh and acid raw but fragrant when cooked. Used for jams, jellies, conserves, and as a flavoring with cooked apples. It is generally used for preserve or fruit wine.

Tejocote

The fruit is used raw or cooked, often used in preserves, jellies, and jams. When stewed they must have the skins removed by boiling with wood ash and boiled in hot syrup like candy apples. Also used as a flavoring for rum, tropical fruit punch, and carbonated drinks.

MEDICINAL USES OF POME FRUITS:

There are several medicinal uses of the pome fruits are they are discussed below for each of the pome fruits.

Apple

Eating two apples or drinking 12 ounces of apple juice daily was shown to reduce build-up of arterial plaque. The bark and roots of most *Malus* species contain phloretin, and antibiotic-like compound that acts on certain bacteria

Azarole:

Although no specific mention has been seen for this species, the fruits and flowers of many hawthorns are well-known in herbal folk medicine as a heart tonic and modern research has borne out this use. The fruits and flowers have a hypotensive effect as well as acting as a direct and mild heart tonic. They are indicated in the treatment of weak heart combined with high blood pressure. It is normally used either as a tea or a tincture.

Crabapple

The bark of Western crabapple was used, alone or with other plant products, for a variety of medicinal treatments for the eyes and for the stomach and digestive tract. The Western crabapple is used by several native North American Indian tribes to treat a variety of complaints. The trunk, bark and inner bark are antirheumatic, astringent, blood purifier, cardiac, diuretic, laxative and tonic The trunk, bark and inner bark are antirheumatic, astringent, blood purifier, cardiac, diuretic, laxative and tonic.

Loquat:

Leaves and fruit have been used for medicinal purposes. It has claims to reduce inflammation, bronchitis, and lung congestion.

Mayhaw:

Medicinal products used for back pain, dysentery, high blood pressure, high cholesterol, and cure diseases. The Meskawakis Indians used unripe *Crataegus tomentosa* fruit for bladder ailments; these fruit also have hypotensive (lowers blood pressure) and antiarrhythmic activity (counters irregular heartbeat). Seeds of hawthorns are sometimes boiled or roasted, and made into a coffee-like beverage (*Sorbus* fruit also used for this). *Crataegus oxycantha* leaves are substituted for tobacco and smoked, causing a mild stimulant effect.

Medlar:

There is a single recommendation of a remedy for kidney stones that proposes that Medlar leaves be boiled and drunk as tea until the stone is ejected. Although the fruit is edible, it is not considered GRAS (Generally Recognized as Safe).

Quince

The stem bark is astringent and it is used in the treatment of ulcers. The seed is a mild but reliable laxative, astringent and anti-inflammatory. When soaked in water, the seed swells up to form a mucilaginous mass. This has a soothing and demulcent action when taken internally and is used in the treatment of respiratory diseases, especially in children. This mucilage is also applied externally to minor burns etc. The fruit is antivinous, astringent, cardiac, carminative, digestive, diuretic, emollient, expectorant, pectoral, peptic, refrigerant, restorative, stimulant and tonic. The unripe fruit is very astringent; syrup made from it is used in the treatment of diarrhea and is particularly safe for children. The fruit, and its juice, can be used as a mouthwash or gargle to treat mouth ulcers, gum problems and sore throats. The leaves contain tannin and pectin. Tannin can be used as an astringent while pectin has a beneficial effect on the circulatory system and helps to reduce blood pressure.

Quince, Chinese and Quince, Japanese:

The fruit is analgesic, anti-inflammatory, antispasmodic, astringent and digestive. A decoction is used internally in the treatment of nausea, joint pains, cholera and associated cramps. The dried peel can be used for expectorant and antidiarrheic.

Tejocote

The fruits and flowers of tejocote is well-known in herbal folk medicine as a heart tonic

POME FRUIT EQUIVALENTS AND YIELDS:

Table 35 shows the pome fruit equivalents for an individual fruit, for example one large apple (242g) yields ¾ cup of apple sauce and 1 3/8 – 1 1/2 cup of sliced apples. One medium apple yields 3/4 cup of apple juice or 1/2 cup of applesauce 1 1/4 apple yields one serving of apple juice (8 oz. or 240 ml) which equals 120 calories.

Table 35. Pome Fruit Equivalents and Equivalents and Their Food Yields (U.S. Apple Association).

Apple Equivalents Quantities are approximate amounts. Quantities may change slightly due to varying apple sizes.				
Quantity of Apples	**Sliced**	**Diced**	**Grated**	**Sauce**
1 Small	5/8 to 3/4 C.	3/4 C.	1/2 C.	1/3 C.
1 lb. - 4 Small	2 3/4 C.	3 C.	2 C.	1 1/3 C.
1 Medium	7/8 to 1 C.	1 C.	3/4 C.	1/2 C.
1 lb. - 3 Medium	2 3/4 C.	3 C.	2 1/4 C.	1 1/2 C.
1 Large	1 3/8 to 1 1/2 C.	1 1/2 C.	1 1/2 C.	3/4 C.
1 lb. - 2 Large	2 3/4 C.	3 C.	3 C.	1 1/2 C.
Miscellaneous Apple Equivalents				
1 1/2 to 2 lbs.	One 9" Pie			
1 Peck	10 1/2 to 12 lbs.			
1 Bushel	42 – 48 lbs.	20 - 24 quarts - Applesauce 18 - 20 quarts - Canned or Frozen Slices		
24 lb apples (1/2 bushel) + 2 quarts water	Yields 6 quarts of apple juice.			
1 C. Dried Apples	Approximately 1 1/4 C. Cooked Apples			
4 C. Apple Juice	Three lb tart apples + 3 cups water + 3 cups sugar yields 4 half pints of apple jelly.			

Sixty-four percent of the 2005 U.S. apple crop was eaten as fresh fruit, 36 percent was processed into apple products, and less than 1 percent was not marketed. The average consumer ate about 65 apples or 22 lb/person annually. Of the apples that were processed, 51 percent were used for juice and cider; 5 percent were dried; 7 percent were frozen; almost 2 percent were used to make fresh apple slices and 32 percent were canned. Other uses included baby food, apple butter or jelly, and vinegar.

USDA MARKETING STANDARDS FOR POME FRUITS:

The USDA Agricultural Marketing Service (USDA AMS USDA AMS 1955a: USDA, AMS. 1955b, and USDA AMS 2002) has established standards for marketing many of the pome fruits. For apples the U.S. grades are U.S. extra fancy, U.S. fancy, and U.S. No. 1 based on color requirements, freedom from decay, disorders, freeze injury, visible water core, blemishes, and lack of insect damage as well as firmness of the fruit. There are minimum color standards specified for twelve apple varieties such as Red delicious, 'Empire', 'Jonathan', and 'Rome Beauty'. Grade for 'Red Delicious' apples is based primarily on the percentage of red color. Extra Fancy grade must have 70 % red color, while fancy grade must be 40 %. 'Golden Delicious' colors range from dark green to yellow. Size standards are based on diameter or weight in grams. Red delicious size and weight ranges from 2 1/8 inches diameter or 65 grams to 2 3/4 inches or 139 grams. 'Red delicious' size and weight ranges from 2 1/8 inches diameter or 65 grams to 2 3/4 inches or 139 grams. Fall, winter, and pear standards are U.S. No. 1 and U.S. No. 2 based on variety, free from decay, scald, freeze and insect injury, and mechanical injury. Pears can vary in size from 2 ½ minimum to 2 ¾ maximum inch traverse diameter. Quality standards for pears also depend on color and freedom from blemishes. Approximate apple sizes can vary between varieties with a small size being 2 1/4 inch diameter and 4 oz in weight (Table 36).

Table 36. Approximate Apple Sizes (Size will vary between varieties)

Size	Diameter	Approximate Weight	Apples per Pound
Small	2 1/4"	4 oz.	4
Medium	2 3/4"	5 oz. to 7 oz.	3
Large	3 3/4"	8 oz. or more	2

AVAILABILITY AND STORAGE LIFE OF THE POME FRUIT CROP GROUP MEMBERS IN THE MARKETPLACE:

Pome fruits are widely available in the marketplace both from domestic production and imports. The available and peak production periods for apples, pears, and Asian pears in the marketplace are shown in Tables 37, 39, and 41, respectively. Washington State and Canada have apples available during the whole year (Table37). Apple variety availability is shown in Table 38 with 'Red Delicious', 'Golden Delicious' and Granny Smith' are available during the whole year. Specific descriptions of each apple variety and their uses as a fruit are discussed in Appendix II. Pears are available for the whole

year from Washington and Oregon (Table 39). In most cases based on U.S. production and imports pome fruits are now available all year around.

Table 37. Availability of Apples in the U.S. Marketplace (A = Available, P = Peak).

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Washington	P	P	P	P	P	P	P	P	P	P	P	P
New York	P	P	P	P	P	P			P	P	P	P
Michigan	A	A	A	P	P	P	P	P	A	A	A	A
Pennsylvania	P	P	P	P	P	P	P	P	A	A	A	P
California	P	P	P	P	P	P			P	P	P	P
Oregon	P	P	P	P	P	P	P	P	P	A	P	P
North Carolina								P	A	P		
Canada	P	P	P	P	P	P	P	P	P	P	P	P
New Zealand					P	P	P	P				

Table 38. Apple Variety Availability

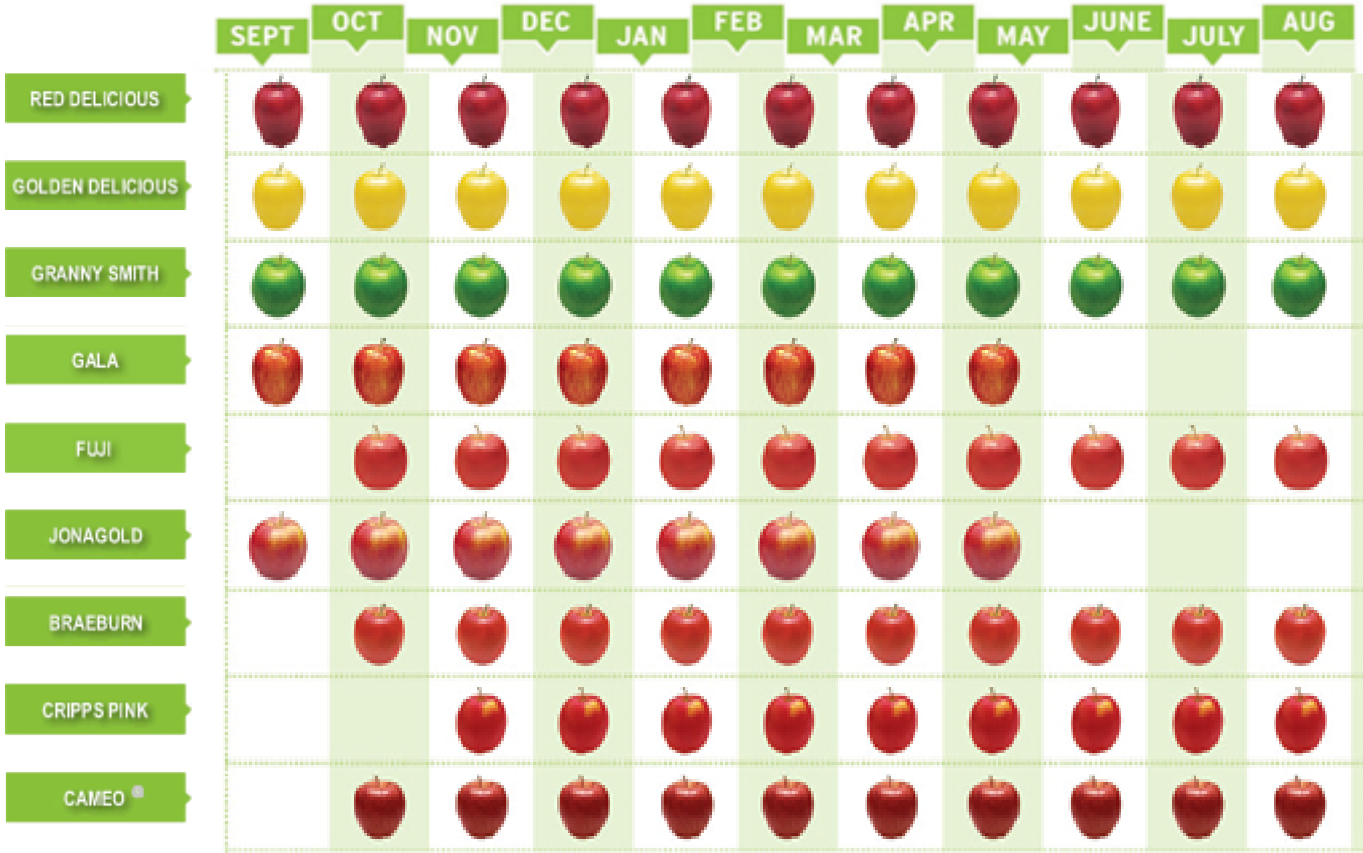


Table 39. Availability of Pears in the U.S. Marketplace (A = Available, P = Peak).

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
California							P	P	P	P	P	A
Idaho								A		A		
Oregon	P	P	P	P	P	A	A	A	A	P	P	P
Washington	P	P	P	P	A	A	A	A	A	P	P	P
Argentina		P	P	A	A	A						

Pears rank second to the apple as the most popular U.S. fruit. They can be eaten and used in a lot of similar ways as the apple. One distinct feature of the pear besides the shape is the soft texture. This soft texture is the result of the starch converting to sugar after being picked from a tree to ripen. With the numerous varieties and extended growing seasons, pears of all sizes and colors are available year-round. There are several varieties of pears including 'Anjou', 'Bartlett', 'Bosc', 'Comice', 'Forelle', and 'Seckel' (Tables 39). These fruits have a sweet, rich flavor and come in a variety of colors including green, golden yellow and red. Among these varieties there are only subtle differences in flavor and texture. Pears come in a variety of shapes, sizes, and colors from tiny 'Seckel' to long-necked 'Bosc to the colorful 'Red Bartlett's'.

Table 40. Availability of Pear Varieties in the U.S.

Pear Variety	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Green Anjou	X	X	X	X	X	X				X	X	X
Red Anjou	X	X	X	X	X					X	X	X
Yellow Bartlett								X	X	X	X	X
Red Bartlett								X	X	X	X	X
Bosc	X	X	X	X				X	X	X	X	X
Comice	X	X	X					X	X	X	X	X
Forelle	X	X							X	X	X	X
Seckel	X	X						X	X	X	X	

The 'Green Anjou' is available from October through June (Table 40). It is firm and green, even when ripe; this large, thin-skinned yellowish-green pear is best eaten fresh. When slightly under ripe, it can be baked or poached, but once it ripens, its sweet, mellow flavor and juice make it an excellent choice for salads and snacks. The 'Red Anjou' is available October through May and has much the same flavor, use and texture as the 'green Anjou'. The 'Red Anjou' are generally dark, maroon red in color show little to no change in color as they ripen, which is another characteristic shared with their

'Green Anjou' counterparts. The 'Red Anjou' is recognizable for their near egg-shaped appearance. The 'Yellow Bartlett' is available August through December and is one of the most common and popular pears. This large, bell-shaped all-purpose pear has a yellow skin sometimes blushed with pale red. It is very sweet, juicy, aromatic and perfect for salads, eating fresh, and excellent for canning or cooking. It holds its shape and flavor in baking and cooking. The 'Red Bartlett' is available August through December and ha s a firm, bright red skin, very sweet and juicy when ripe. This variety is a bit smaller, with the same flavor, texture, and use as 'Yellow Bartlett's'. They make a good choice as a color accent in a fresh-fruit dessert or salad. The 'Bosc' is available August through April and has a firm dense, yet tender flesh with brown skin that has a sweet and spicy flavor. Its dense flesh makes it good for baking and cooking. Color doesn't change as it ripens, excellent for baking. Its mild, not-too-sweet flavor is useful for microwave recipes, salads, and snacks. The 'Comice' is available August through March and is hard, green, and rounder than a Bartlett, but similar in flavor and texture. It is one of the largest, sweetest and juiciest varieties. Best used fresh in salads, served as a dessert pear, or as an accompaniment with cheese. The 'Forelle' is available September through February and is slightly larger than a 'Seckel', with freckled skin and a red blush. They are an excellent snack or lunch-box pear, sweet, juicy, and crisp. The 'Seckel' is available August through February and as a small pear that has an ultra-sweet flavor, so sweet in fact they are often called "sugar pears." Maroon and olive green in color, with no color change when ripened. They are also a good choice for children's snacks, for pickling, or as a garnish.

Asian pears are available from California from July through February. (Table 41). Oregon and Washington produce Asian pears from July – October. The Imports of Asian pears from Chile are available during March – April, while Japan and New Zealand are available from July – October.

Table 41. Availability of Asian Pears in the U.S. Marketplace (A = Available).

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
California	A	A					A	A	A	A	A	A
Washington							A	A	A	A		
Oregon							A	A	A	A		
Chile			A	A								
Japan							A	A	A	A		
New Zealand							A	A	A	A		

Storage Life of Pome Fruits:

The pome fruits have relatively long storage lives (Table 42). Apples can be stored for one month to a year at temperatures ranging from 30 - 40° F, while pears can be stored for two to seven months .at temperatures ranging from 29 - 31° F. Quince has the shortest storage times at two – three months. The pome fruits are climacteric fruits that respond to ethylene gas and will ripen in storage. Pears are stored just below freezing up to several months, and then ripened for a few days at 70 - 75° F prior to consumption or canning. Unlike apples, pears are not subject to chilling injury. 'Bartlett' can only be stored for a few months, whereas 'Anjou' and 'Winter Nelis' can be stored for 5 - 7 months. If pears are unripe, place them in a paper bag at room temperature for 2 to 3 days or store them in a ventilated fruit bowl in a cool, dark place, and refrigerate as soon as they ripen. Ripe pears should be stored in the refrigerator in a plastic bag up to 3 days. They continue to ripen after harvest.

Table 42. Approximate Storage Life of Pome Fruits in Commercial Storage (Adapted Hardenburg, et al., 1986, Gast, 1991).

Commodity	Approximate Storage Life With Proper Storage Temperatures
Apple	1 – 12 months
Asian Pear	4 - 6 months
Loquat	1 - 2 months
Pear	2 - 7 months
Quince	2 – 3 months

CHANGES TO EPA DATABASES NEEDED FROM REVISIONS TO THE POME FRUIT CROP GROUP:

The revisions to the amended Pome Fruit Crop Group 11 will affect the need to update many Risk Assessment Models, Residue Chemistry Guidelines, OPP databases, and/or HED Standard Operating Procedures (SOP).

The affected EPA databases may include the following:

(1) **Risk Assessment Models** - The terminology in the Food Exposure Modules of our current Risk assessment Models from DEEM-FCID, Lifeline, and Cares will need to be updated to reflect new terminology and the new Crop Group terminology.

(2) **EPA Residue Chemistry Test Guidelines (OPPTS 860.1000, Background)**, Table 1 Raw Agricultural and Processed Commodities and Feedstuffs Derived from Crops and EPA Residue Chemistry Test Guidelines (OPPTS 860.1000, Background), EPA Residue Chemistry Test Guidelines (OPPTS 860.1500, Crop Field Trials), Table 5

Suggested Distribution of Field Trials by Region for Crops Requiring > 3 trials and Table 6 Regional Distribution of Crop Production.

Any differences between the EPA and NAFTA Crop Production Regions after the NAFTA Regions are updated will be addressed by the ICCGR Workgroup or by the EPA HED ChemSAC with attendance by Canada, PMRA and Mexico. The EPA Residue Chemistry Test Guidelines (OPPTS 860.1500, Crop Field Trials) Table 5 Suggested Distribution of Field Trials by Region for Crops Requiring >3 trials and Table 6 Regional Distribution of Crop Production will be updated to reflect more recent crop production information. There is currently no conflict with Canada.

(3) **Health Effects Division Standard Operating Procedures: HED SOP 99.3 -– "Translation of Monitoring Data" issued March 26, 1999.** This policy provides guidance on translating pesticide monitoring data from one commodity to other similar commodities. Most of the monitoring data is from the USDA Pesticide Data Program (PDP) or the Food and Drug Administration (FDA). The policy is based on the crop groupings in the 40 CFR 180.41.

There is an entry for apple or pear which can be translated to all members of the Pome Fruit Crop up 11. USDA PDP peels the apple or before they analyze them for pesticide residues. The policy does not have to be updated at this time, since it will be still be applicable to the whole crop group.

(4) **HED SOP 99.6 - "Classification of Food Forms with Respect to Level of Blending" issued August 20, 1999.** This SOP provides rationale and guidance to HED on revised criteria for inputting residue values and pesticide usage information into acute dietary exposure and risk assessments based on commodities. These revisions permit the Agency to more fully utilize data generated by the USDA Pesticide Data Program.

Some of the Pome Fruit Crop Group members are included in the HED SOP 99.6. See Table 43 below. Other members not in the original SOP will need to be added to the HED SOP 99.6. The whole fruits are not blended and can be uncooked, cooked, baked, boiled, or canned.

TABLE 43. Classification of Food Forms with Respect to Level of Blending for the Pome Fruit Crop Group. (HED SOP 99.6, April 20, 1999).

COMMODITY	FOOD FORM	CLASSIFICATION
Apple	11 - Uncooked	NB – Not blended
Apple	12 – Cooked: NFS	NB – Not blended
Apple	13-- Baked	NB – Not blended
Apple	14 – Boiled	NB – Not blended
Apple	15 - Fried	NB – Not blended
Apple	18 - Dried	B - Blended
Apple	31 – Canned: NFS	PB - Partially blended
Apple	32 – Canned: Cooked	PB - Partially blended
Apple	33 – Canned: Baked	PB - Partially blended
Apple	34 – Canned: Boiled	PB - Partially blended
Apple	42 – Frozen: Cooked	PB - Partially blended
Apple – dried	13-- Baked	PB - Partially blended
Apple - dried	14 – Boiled	PB - Partially blended
Apple - dried	18 - Dried	PB - Partially blended
Apple - dried	42 – Frozen: Cooked	PB - Partially blended
Apple - juice/cider	11 - Uncooked	PB - Partially blended
Apple - juice/cider	12 – Cooked: NFS	PB - Partially blended
Apple - juice/cider	14 – Boiled	PB - Partially blended
Apple - juice/cider	31 – Canned: NFS	PB - Partially blended
Apple - juice/cider	41 – Frozen: NFS	PB - Partially blended
Apple - juice-concentrate	12 – Cooked: NFS	PB - Partially blended
Apple - juice-concentrate	13-- Baked	PB - Partially blended
Apple - juice-concentrate	31 – Canned: NFS	PB - Partially blended
Apple - juice-concentrate	41 – Frozen: NFS	PB - Partially blended
Pear	11 - Uncooked	NB – Not blended
Pear	2 – Cooked: NFS	NB – Not blended
Pear	13-- Baked	NB – Not blended
Pear	14 – Boiled	NB – Not blended
Pear	31 – Canned: NFS	NB – Not blended
Pear - dried	13-- Baked	PB - Partially blended
Pear - dried	14 – Boiled	PB - Partially blended
Pear - dried	18 - Dried	PB - Partially blended
Pear - juice	11 - Uncooked	PB - Partially blended
Pear - juice	12 – Cooked: NFS	PB - Partially blended
Pear - juice	13-- Baked	PB - Partially blended
Pear - juice	31 – Canned: NFS	PB - Partially blended
Pear - juice	33 – Canned: Baked	PB - Partially blended
Pear - juice	41 – Frozen: NFS	PB - Partially blended
Pear - juice	42 – Frozen: Cooked	PB - Partially blended

(5) **HED SOP 2000.1 – "Guidance for Translation of Field Trial Data from Representative Commodities in the Crop Group Regulation to Other Commodities in Each Crop Group/Subgroup" issued September 12, 2000.**

There is guidance in the SOP for the current Pome Fruit Crop Group, but not for the additional proposed commodities, so the current Crop group 11 will be listed below followed by a listing of the proposed Pome fruit group below:

Current Crop Group 11: Pome Fruits

Representative Commodities: Apple and pear

CROP GROUP COMMODITY	REPRESENTATIVE COMMODITY
Apple	Apple
Crabapple	Apple
Loquat	Pear
Mayhaw	Apple
Pear	Pear
Pear, oriental	Pear
Quince	Pear

Proposed Crop Group 11 - 09: Pome Fruits

Representative Commodities: Apple and pear

CROP GROUP COMMODITY	REPRESENTATIVE COMMODITY
Apple	Apple
Azarole	Apple
Crabapple	Apple
Loquat	Pear
Mayhaw	Apple
Medlar	Apple
Pear	Pear
Pear, Asian	Pear
Quince	Pear
Quince, Chinese	Pear
Quince, Japanese	Pear
Tejocote	Pear

(6) The HED Dry Matter Database will be updated to add the Table below:

Table 44. Health Effects Division Dry Matter and Seeding Rate Database. Pome Fruit Crop Group. Prepared by Dr's. NG and B. A. Schneider. June 2008.

Commodity	% Dry Matter
Apple	14.4, 15.0, 15.2, 16.0, 18.0
Apple, dried	68.3
Apple, dried pomace	88.0
Apple, juice	12.0
Apple, wet pomace	23.0
Crabapple	21.1
Loquat	10.0. 13.3. 15.0
Medlar	25.0, 30.0
Pear	14.8, 16.0, 16.2, 16.3, 17.0
Pear, Asian	11.7, 11.75, 12.0
Pear, dried sulfured	73.0, 73.3
Quince	16.0, 16.2

COMMODITY DEFINITIONS [(40 CFR § 180.1(g)]:

There are currently no commodity definitions for any commodity in the Pome fruit group. A commodity definition for crabapple which lists all the types of crabapples is proposed with this petition and will be discussed below:

Proposed 40 CFR § 180.1(g):

Tolerances and exemptions established for pesticide chemicals in or on the general category of raw agricultural commodities listed in column A apply to the corresponding specific raw agricultural commodities listed in column B. However, a tolerance or exemption for a specific commodity in column B does not apply to the general category in column A.

A B ----------

Proposed Crabapple Commodity Definition:

Crabapple----------Crabapple, *Malus* spp. (*Rosaceae*) (Chinese apple, Chinese crabapple, Chinese flowering apple, Crabapple, Cutleaf crabapple, Florentine crabapple, Hall crabapple, Iowa crabapple, Japanese crabapple, Kai do crabapple, Manchurian crabapple, Paradise apple, Sargent's crabapple, Siberian crabapple, Soulard crabapple, Southern crabapple, Sweet crabapple, Tea crabapple, Toringa crabapple, Western Crabapple, Yunnan crabapple, and varieties and/or hybrids of these.

HED Recommendation on Commodity Definition for Crabapple:

I recommend ChemSAC **reject** a Crabapple commodity definition under 40 CFR Part 180.1(g) because these crabapples will be listed in the EPA Food and Feed Commodity Vocabulary (http://www.epa.gov/pesticides/foodfeed) as lookup terms and the preferred term for all of these will be crabapple.

TOLERANCE EXPRESSION GUIDANCE:

Until the Federal Register Notice is issued revising the Crop Group Regulation to establish the amended Pome Fruit Crop Group 11 the commodities approved for the crop group will have to be listed as separate commodities at the same tolerance level. When ChemSAC approves the Pome fruit crop group 11, the Risk Integration, Minor Use, and Emergency Response Branch (RIMUERB) of the Registration Division can immediately implement the amended Crop Group with new tolerance expressions located in the Section F submissions. The three tolerance expression examples will provide an expedited way to establish tolerances in or on Pome fruit crops, especially for new reduced risk pesticides, without requiring additional residue data for all the crops noted. This will create a practice in the United States which is already formalized in Canada and promote international harmonization. Several tolerance expression examples for guidance purposes for use by RIMUERB and HED reviewers will be listed below:

Example 1. What is the tolerance expression for the amended Pome Fruit Crop Group 11?

Answer to Example 1:

The tolerance expression for the amended Pome Fruit Crop Group 8 will be "Fruit, pome, group 11 - 09."

Example 2. How will the Crop group appear in the Federal Register for the proposed crop group regulation [40CFR 180.41(c)]? This example is for the Field and External Affairs Division (FEAD) and Registration Division (RD) use in preparing the new Federal Register Regulation. The example follows the same format as the current Crop Grouping Regulation Federal Register Notice (FR 60, No.95, 5/17/95, 26626-26643).

Answer to Example 2:

"Crop Group 11 - 09: Pome Fruit Crop Group".

Representative commodities. Apple and pear

Commodities
Apple, *Malus domestica* Borkh.
Azarole, *Crataegus azarolus* L.
Crabapple, *Malus sylvestris* (L.) Mill., *Malus prunifolia* (Willd.) Borkh.
Loquat, *Eriobotrya japonica* (Thunb.) Lindl.
Mayhaw, *Crataegus aestivalis* (Walter) Torr. & Gray, *C. opaca* Hook. & Arn., and *C. rufula* Sarg.
Medlar, *Mespilus germanica* L.
Pear, *Pyrus communis* L
Pear, Oriental, *Pyrus pyrifolia* (Burm. f.) Nakai var. *culta* (Makino) Nakai
Quince, *Cydonia oblonga* Mill.
Quince, Chinese, *Chaenomeles speciosa* (Sweet) Naka, *Pseudocydonia sinensis* (Thouin) C.K. Schneid.
Quince, Japanese, *Chaenomeles japonica* (Thunb.) Lindl. Ex Spach
Tejocote, *Crataegus mexicana* DC.

Cultivars, varieties and/or hybrids of those above commodities

Example 3: How will I express the tolerances on an interim basis until the Federal Register Notice is final for the Pome fruit group 11 - 09, for example at a tolerance level of 1.5 ppm? This example will be useful for the Registration Division (RD) and Health Effects Division (HED) to prepare tolerance tables. All the new proposed commodities will have to be listed separately from the crop group tolerance and at the same level as the crop group.

Answer to Example 3:

Commodity	Parts per million (ppm)
Apple	1.5
Azarole	1.5
Crabapple	1.5
Loquat	1.5
Mayhaw	1.5
Medlar	1.5
Pear	1.5
Pear, Oriental	1.5
Quince	1.5

Commodity	Parts per million (ppm)
Quince, Chinese	1.5
Quince, Japanese	1.5
Tejocote	1.5

Cultivars, varieties and/or hybrids of those above commodities

EPA FOOD AND FEED COMMODITY VOCABULARY FOR THE POME FRUIT CROP GROUP:

The following terms for the pome fruit commodities will be incorporated to the EPA Food and Feed Commodity Database (http://www.epa.govopp/foodfeed). The Table 45 below is identical to the current Food and Feed Commodity Vocabulary format. A search of the lookup terms will link to the EPA preferred tolerance/commodity term, and the Base crop/animal term is the specific crop animal terms associated with the preferred term. Until the Federal Register Notice for the Crop Group is final, the Crop Group designation on each term will be listed as no crop group and given the crop group 99 for the present.

Table 45. EPA FOOD AND FEED COMMODITY VOCABULARY

SEARCH OR LOOKUP TERM FOR POME FRUIT COMMODITIES	PREFERRED TOLERANCE TERM	BASE CROP/ANIMAL TERM
Apple; Manzano; Pomme; Manzana; Pommier commun; Apfel; Apfelbaum; Kultur-Apfel; Ringo; Macieira; Peron	Apple	Apple
Azarole; Mediterranean medlar; Medlar, Mediterranean	Azarole	Azarole
Crabapple; Applecrab; Chinese crabapple; Siberian crabapple; Shan jing zi; Pommier à baies; Pommier à petits fruits; Beerenapfelbaum; Beerenapfelstrauch; Osagedorn; Manzano; Southern crabapple; American crab; Southern wild crabapple; Wild crab; schmalblättriger Apfel; Japanese flowering crabapple; Purple chokeberry; showy crabapple; Paradise crabapple; Paradise apple; Prairie crabapple; Wild crabapple; Siberian crabapple; Manzano; Sweet crabapple; Wild sweet crab; Sweet scented crab; Alaska-Apfel; Pacific crabapple; Western crabapple; Oregon crabapple	Crabapple	Crabapple
Loquat; Japanese plum; Japanese medlar; Nispero; Nispero-del-Japon; Japanese-medlar; Lukwart; Pi ba bibassie;, Néflier du Japon; Japanische Mispel; Japanische	Loquat	Loquat

SEARCH OR LOOKUP TERM FOR POME FRUIT COMMODITIES	PREFERRED TOLERANCE TERM	BASE CROP/ANIMAL TERM
Wollmispel; Níspero del Japón; Nispolero		
Mayhaw; Eastern mayhaw; May hawthorn; Mayhawthorn; Lori mayhaw; Lindsey mayhaw; Eastern mayhaw; Riverflat hawthorn; Texas super berry; Big red mayhaw; Applehaw; Western mayhaw;Rusty hawthorn; Rufous mayhaw	Mayhaw	Mayhaw
Medlar; Northern loquat; Néflier; Deutsche Mispel; Mispelbaum; Nespereira; Níspero común; Níspero europeo	Medlar	Medlar
Pear; Common pear; European pear; Pera; Poirier; Peral; Birnbaum; Poire; Birnbaum; Birne; Birnenbaum; Pero; Seiyo-nashi; Pereira; Peral	Pear	Pear
Oriental pear; Pear, Asian; Asian pear; Apple pear; Sand pear; Nashi; Mizunaski; Salad pear; Apple pear; Chinese pear; Japanese pear; Nashi pear; poirier japonais; Nashi-Birne; Sandbirnbaum; Yama-nashi; Pera; Nakai; Harbin pear	Pear, Asian	Pear, Asian
Quince; Golden apple; Membrillo; Wen po; Cognassier; Coing; Quitte; Quittenbaum; Marmelo; Membrillero; Membrillo	Quince	Quince
Quince, Chinese; Mu gua; Tie geng hai tang; Boke; Sweet Nakai; Chinese-quince; Ma gua; marmeleiro-da-China	Quince, Chinese	Quince, Chinese
Quince, Japanese; Flowering-quince; Quince, flowering; Japanese quince; marmeleiro-do-Japan	Quince, Japanese	Quince, Japanese
Tejocote; Mexican hawthorn; Manzanita tejocotera; Chiste; Manzanilla; Manzanita	Tejocote	Tejocote

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APPENDIX I: Maps of the Total Acres for Apples and Pears - 2002.

Figure 1. Map of US Apple Acres - 2002

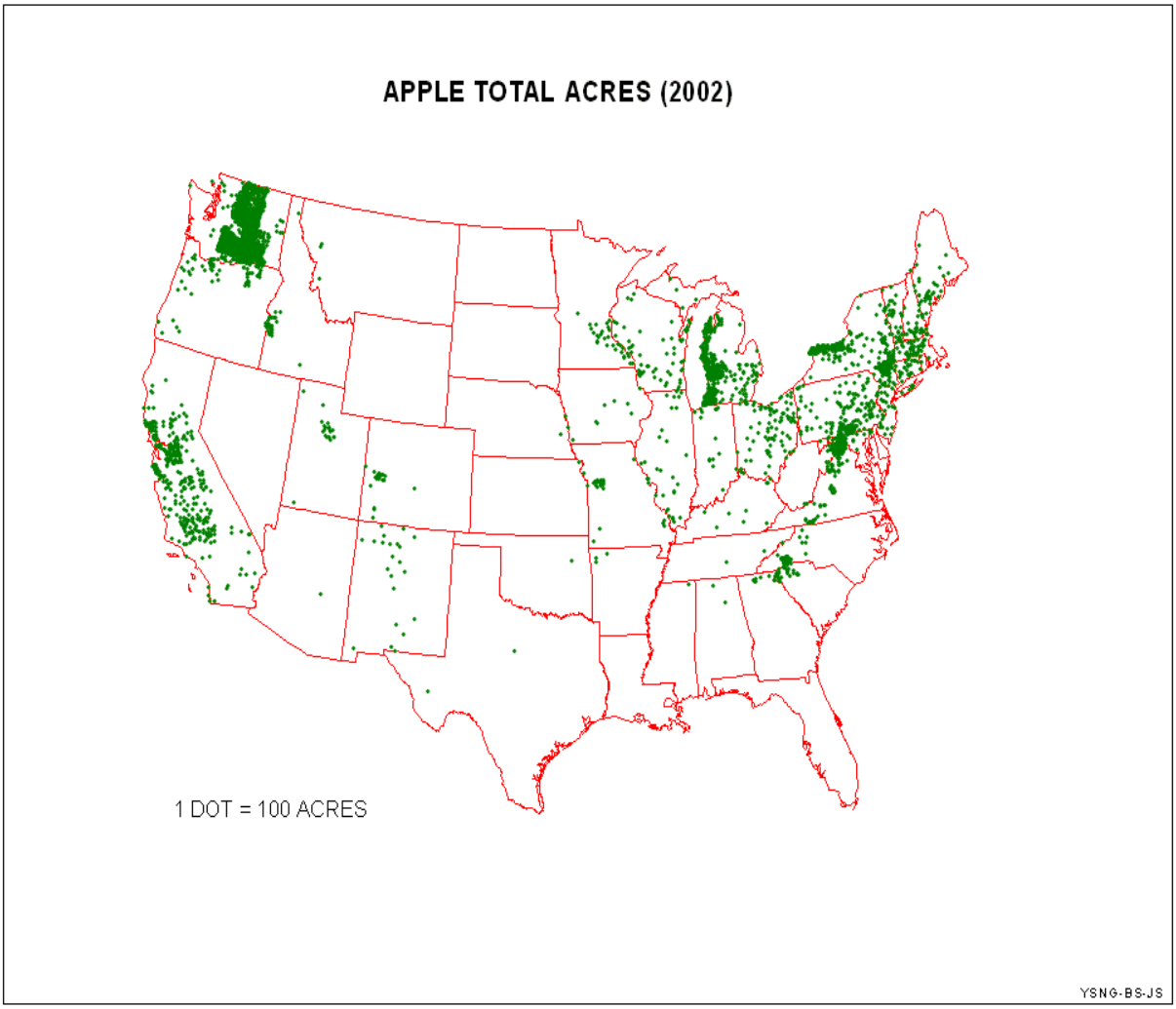
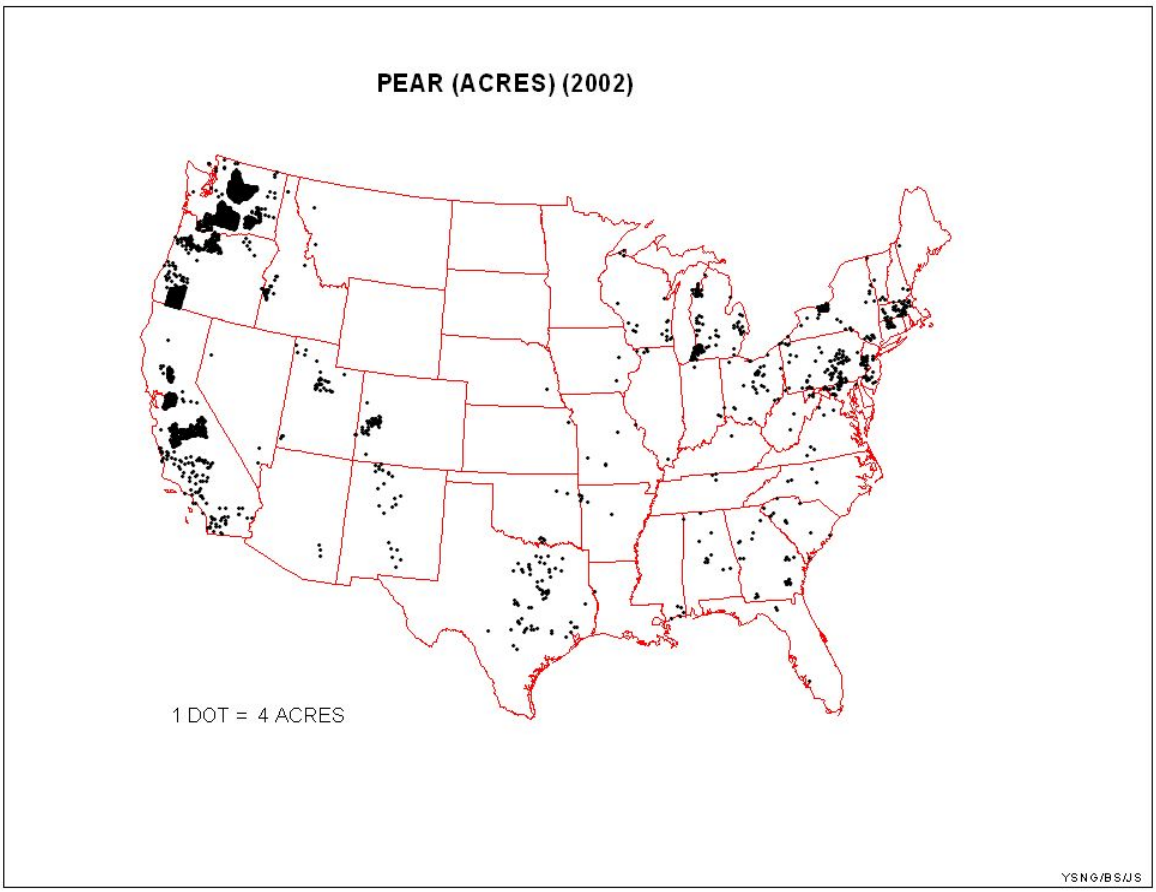

APPLE TOTAL ACRES (2002)
1 DOT = 100 ACRES
YSNG-BS-JS

Figure 2. Map of US Pear Acres - 2002.



APPENDIX II - Apple Variety Characteristics.

Apples

Apples are a round or oval shaped fruit that is harvested from lower growing trees found in most of the temperate regions of the world. The fruit has a thin skin that may range in color from shades of green, yellow, and red or any combination of these. The flesh is generally off-white or cream colored and is very juicy. They are generally sweet flavored but may be slightly sour, tart, or even a bit bland depending on the variety.

Uses:

Apples can be eaten plain, made into sauce or jelly, or they can be included in a variety of salads, meat dishes, pies, and other desserts. As a dried fruit, apples can be added to a variety of baked goods or in a fresh form, they can be used to produce juice, vinegar, cider, and alcoholic beverages, such as hard cider and apple brandy.

At Their Best:

Some apple varieties are available year round and some are only available at specific times of the year. The peak season for apples will vary with different varieties and locations where they are harvested. The best apples are those that are picked fresh from the tree. Fresh picked apples will have the best flavor and an extra crisp texture.

How to Buy:

Buy apples that are brightly colored, firm, and free of bruises or damaged skin. If the flesh gives

under pressure, the apple will be soft. The skin on the apple should be taut and show no signs of shriveling. Apples are graded according to their size and quality. The higher the grade, the more expensive the apple.

Storage:

For best results, place apples in a perforated plastic bag, sprinkle with water and store in the coldest area of the refrigerator for 2 to 3 weeks. Apples give ethylene gas that speeds up ripening, so they should be kept away from other fruits and vegetables to prevent them from ripening prematurely. Apples can be stored at room temperature for a short period of time but should be checked regularly because they will ripen more rapidly than if stored in the refrigerator. To store fresh picked apples for a long period of time, wrap them in paper and place folded side down in a single layer on a tray. Store in a cool, dark, dry place. The ideal temperature for apple storage is between 32F and 40F. Dried apples can be stored in a sealed plastic bag in the refrigerator for an indefinite period of time.

Varieties:

Ambrosia Apple 	A medium size apple with red color with some striping on a creamy yellow background. The ambrosia apple does not have a long storage life so it should be used within approximately four months of harvesting. The apple originated from British Columbia and is a good snacking apple with its crisp texture and juicy aromatic flesh. Its flesh does not oxidize and turn brown as quickly as other apples so it is good in salads.
Arkansas Black Apple 	A small to medium size deep red apple whose red color turns to a deep purplish red and at times almost looks black. It originated in Arkansas and is thought to possible be an offshoot of a Winesap apple. It has a firm, crisp, yellow flesh that has a tart aromatic flavor. The Arkansas Black apple stores well in cold storage. It will keep its freshness for 6 months when stored properly.
Baldwin Apple	A red-skinned apple that has streaks of yellow and is heavily speckled with russet spots. It is an all-purpose apple has a sweet-tart flavor with a slight spiciness to it. It has a crisp texture, which holds up well when cooked. Its slightly spicy flavor makes it a good choice for making cider and pies. Baldwin's are not always easy to find.

	
Braeburn Apple 	A variety of apple that is very firm with a sweet and slightly tart flavor. It may range in color from greenish-gold to red and is popular as a snack or served in salads and desserts.
Cameo Apple 	A fairly new variety of apple that is thought to be a cross between Red and Golden Delicious apples. It has a creamy yellow colored background with red striping over it. The Cameo apple has crisp, juicy flesh with a sweet flavor and a touch of tartness. It is a good apple for snacking and to use fresh in salads. It is also a good cooking apple and makes great desserts. The Cameo stores well when refrigerated.
Connell Red Apple 	A large size apple that is bright solid red or striped red in color. The Connell Red is a version of Fireside but is redder in color. It is slightly crisp and has a sweet flavor, which makes it a good eating apple. Connell Red apples have a firm texture that holds up well when cooked, making it a good choice for pies and sauces.

Cortland Apple 	A type of apple that has a sweet and tart flavor with creamy white flesh covered with a red skin. It is an excellent choice for use in cooked apple dishes.
Crabapple 	A variety of apple that is very small in size, usually no larger than 1 to 2 inches in diameter. The outer skin may be yellow, green or red when mature and the inner flesh is a firm to hard texture. Crabapples are known for their tart flavor and they are often used to make a jelly, wine, apple butter, and other foods.
Crimson Gold Apple 	A small variety of apple that is slightly larger than a crabapple, but much smaller than a traditional apple. The Crimson Gold Apple was developed as a cross between a Newton and Spitzenburg heirloom apple. It is a variety of apple that grows well in climates with warmer daytime temperatures with cooler evenings, to develop higher sugar content. As it matures, this apple has a firm textured flesh that is crisp and sweet flavored. When selecting, choose apples with unblemished skins that are firm to the touch.
Criterion Apple	A bright yellow skinned apple with some areas of red blushing. It has a firm, crisp texture and a mildly sweet flavor, which makes it a good eating apple. It is slow to brown when cut open so it makes a good apple in salads and it is also

	makes a good cooking apple.
Elstar Apple 	A cross between a Golden Delicious and Cox's Orange Pippin, it is a medium to large sized apple with a firm cream colored flesh that has a sweet but slightly tart flavor. Its skin has a yellow background streaked with a blushing of red. It is a good all-purpose apple but is excellent for making applesauce.
Empire Apple 	A cross between a Delicious and a McIntosh apple, it is a medium sized apple and has a deep red coloring. The Empire has a crisp, juicy flesh that has a mildly tart but sweet flavor, making it a good snacking apple. It is also excellent for baking and salads.
Fireside Apple 	A variety of apple, also referred to as a Connell Red, that is bright red and typically large in size. The smooth-textured, bright red outer skin covers a firm white flesh that is dense and fine textured, which provides a mildly sweet flavor. This apple stores well for longer periods of time in refrigerated areas. It is a good apple to eat out of hand or to use for cooking. Also, it dehydrates well as a dried fruit.
Fuji Apple	Ranging in color from a light yellow-green with a bit of red to all red, the Fuji apple has a sweet and spicy flavor. The natural sweetness of the apple makes it a good candidate for applesauce because little sugar is required.

	
Gala Apple 	A variety of apple that is small in size and has a skin that is yellowish-orange in color with red stripes. The flavor is sweet and not too tart, so it is a favorite as a snack.
Ginger Gold Apple 	A variety of apple that has pale green outer skin and a cream colored crisp textured flesh. It has a slightly tart flavor that is excellent for baking, cooking or for eating as a snack. It is a variety that turns brown slowly, so it is a good choice for use in fresh cut servings.
Golden Delicious Apple 	A variety of apple that has a pale gold and freckled skin, a firm, crisp texture, and a sweet, mellow taste. The flesh resists browning and they are excellent eaten plain or used for cooking, although they lose some of their flavor when cooked.
Golden Russet Apple 	A medium sized apple that has a distinctive greenish yellow to golden brown skin color. The flesh is firm and cream colored providing a sweet juicy flavor. This apple is a good selection for drying, for baking, and for making cider. It can be kept for months in refrigerated storage.

Golden Supreme Apple 	A medium sized apple that is greenish yellow to golden brown in color with a firm cream-colored flesh that provides a sweet juicy flavor. This apple is a good selection for drying, for baking, and for making cider. It can be kept for months in refrigerated storage.
Granny Smith Apple 	A tart, crisp, juicy apple with freckled green skin that is as suitable for eating as it is for cooking. Granny Smith apples are imported from New Zealand and Australia and they are also grown in the United States, mainly in California and Arizona.
Gravenstein Apple 	A type of apple that typically has a green skin streaked with red, however, it can also be mostly red in color. This apple has a texture that is crisp and juicy with a flavor that is very tart. It is considered to be an all-purpose apple because of its versatility as an ingredient for pies and applesauce as well as its flavor for eating out of hand.
Green Pippin	A large sized apple with a round shape. Its green skin turns a greenish yellow when it is fully mature. Its white flesh is s tender and juicy. The Green Pippin ripens in September and stores well.
Haralson Apple 	A variety of apple that is medium sized, bright red in color with a spot of green, and pronounced small tan-colored spots all over the outer skin. This apple has a firm white flesh that provides a distinctively tart flavor. It is an excellent apple for cooking and baking, as it is commonly used to make pies and desserts. It stores well in refrigerated areas for longer periods of time.
Honeycrisp Apple	A variety of apple that has bright red and pale green outer skin and a cream colored crisp yet juicy inner

	flesh. This apple has a sweet yet slightly tart flavor and it is an excellent apple for salads, baking, cooking, or for eating as a snack.
Honeygold Apple 	A medium to large sized apple that has a round cone-like shape. It is golden yellow to yellowish green in color. It frequently has a blush of red color. Its yellow flesh is sweet, similar to Golden Delicious but with a crisper texture. It is an excellent eating apple and is good in salads. Also works well for applesauce, pies and other baking.
Idared Apple 	A variety of apple that has bright red outer skin and a cream colored crisp textured flesh. They have a slightly tart flavor and hold their shape well making them an excellent choice for baking and cooking. They are also good eating as a snack. Idared apples are also termed as Ida Red.
Jazz™ Apple 	A new variety of apple created in New Zealand and is now making its way into the United States and other areas around the world. It is a cross between the Royal Gala and Braeburn varieties. It has an orange red coloring over a light yellow background and a round shape. It has an exceptionally crisp texture with a tangy sweet flavor.
Jonagold Apple 	A variety of apple that has a creamy yellow flesh with a sweet and slightly tart flavor. The skin color is a warm red with areas of golden yellow. Jonagold apples are juicy and crisp and excellent for most cooked apple recipes or for eating as a snack.
Jonamac Apple	A variety of apple that has bright

	red outer skin and a cream colored crisp textured aromatic flesh. They have a somewhat tart flavor that is excellent for baking, cooking or for eating as a snack.
Jonathan Apple 	A very popular apple variety that is shiny red in color and has a juicy, sweet, and slightly tart flavor, and is used as a snack or in salads and desserts. The peak time of year for its availability is from early fall to late winter.
Lady Apple 	A small-sized apple with a green and red colored outer skin covering a white, firm textured, juicy inner flesh that provides a tart to sweet flavor. It is an apple that can be used for canning, as a garnish, for sauces, or for small snacks. Because of its size and nice appearance, this apple is commonly used to decorate wreaths and fruit baskets during Christmas, hence the reference to it as the Christmas apple. It is a variety that is, at times confused with the Pink Lady apple in name only, but is not related. The Pink Lady was developed in Australia in the early 1970's while the Lady apple is a very old apple.
Liberty Apple 	A medium sized apple that is one of the most disease resistant. It has a conical shape and bright red blushed skin with a little russet around the stem. Its white flesh is crisp, juicy, sweet and just slightly acidic. It is harvested in late September and early October.
Macoun Apple	A small to medium size apple whose skin is colored with a rosy red blush over a green background.

	It has a juicy white flesh that is crisp and juicy with a taste that is sweet but slightly tart. It makes an excellent snacking apple but also works well in salads, pies and applesauce. Macoun apples are generally only available in the fall and they do not keep well.
McIntosh Apple 	A light to dark red apple with tints of green covering a very juicy flesh that provides a sweet, tangy (almost tart) flavor. It makes a good eating and baking apple but when used in pies, a thickener may be necessary due to the juiciness of the apple. When storing, refrigerate the apples to keep for longer periods of time and handle them gently, since they bruise easily.
Melrose Apple 	A variety of apple whose skin is covered in red over a green to yellowish background. The red skin is speckled with tan spots. Its white flesh is crisp and its flavor is sweet but slightly tart. It is a good eating apple and works well as a fresh apple in salads. It also makes good pies and applesauce.
Mutsu Apple 	A greenish yellow to golden yellow colored large apple, which is a cross between a Golden Delicious and an Indo apple. Its greenish yellow skin can have a tint of orange to it at times. It has a creamy white, firm flesh that has a sweet spicy flavor. It is an excellent snacking apple and is also good for baking, salads and sauces. It is also known as a Crispin apple.
Newton Pippin Apple	A good all-purpose apple that is greenish yellow in color. Its light yellow, juicy flesh is extra crispy and slightly tart. When cut or peeled, these apples have a tendency to darken quickly. They are also called Pippin Apples.

	
Northern Spy Apple 	A large sized apple that is covered in red over a green to yellowish background. Its juicy flesh has a sweet but tart flavor and a firm texture. Because of their tartness, they are not as popular as other varieties for eating fresh. This apple is a good selection for drying and for making pies and baked goods.
Northwest Greening Apple 	A variety of apple that is a cross between a Golden Russet and an Alexander. It is a large apple with pale green to yellow outer skin, with a russet area around the stem, and a cream colored firm textured flesh. It has a slightly tart flavor and is a good apple for baking or cooking.
Pacific Queen™ Apple 	A variety of apple that is a result of the same Gala / Splendor cross as is Pacific Rose and also originated in New Zealand. Pacific Queen is darker red in color, has a higher sugar level and ripens earlier than Pacific Rose, but is similar in taste, providing a sweet, crisp inner flesh. This apple is often compared to the Fuji in flavor and is good for eating out of hand or for use in fruit salads.

Pacific Rose™ Apple 	A variety of apple from the Pacific series of apples that originated in New Zealand. Pacific Rose is a cross between a Gala and a Splendor, with a rosy pink to bright red, thin outer skin. Inside, the flesh white, sweet, crisp and juicy. This apple has excellent storage ability. It is often compared to the Fuji in flavor and is good for eating out of hand or for use in fruit salads.
Paula Red Apple 	A variety of apple that has bright red outer skin with yellow to tan spots. This apple has a cream-colored crisp-textured juicy flesh that provides a slightly tart flavor. It is an excellent apple for baking, cooking or for eating as a snack. When making applesauce with this apple, very little sugar generally needs to be added.
Pink Lady® Brand Apple 	A medium-sized fruit that is a cross between the Golden Delicious and the Lady Williams apple. Its skin has a reddish pink coloring over a greenish yellow background. It is a firm, crisp apple with a white flesh, which has a tart-sweet flavor and resists turning brown after being sliced. The apple is used for salads and pies. To preserve the flavor of this apple, keep it refrigerated since heat decreases the texture and good taste.
Pink Pearl Apple 	A small to medium-sized apple that has a creamy colored skin with light to dark pink blushing. The outside appearance of the apple is not as attractive as other apples but once it is cut open its beauty can be appreciated. The bright pink flesh is sure to catch anyone's eye. Its pink flesh has a sweet-tart flavor, which makes it a good eating apple. It also makes good pies and sauce. This apple must be handled with care because it bruises easily. They should be used fairly soon after purchasing because they do not store as well as other varieties of apples.

Red Delicious Apple 	A large, bright red apple with an elongated shape that has five distinctive knobs on the bottom. It is deliciously sweet and juicy, making it a good apple to eat out of the hand. It does not work well for cooking.
Rhode Island Greening Apple 	A green to yellow colored apples that is medium sized with a russet area around the stem. The inner flesh is firm textured, white and tart flavored. It is great for pies, applesauce and other cooking needs because of its sweet-tart flavor that intensifies when it is cooked. This variety of apple is generally found in the central and eastern regions of the U.S. The variety found in the western region that compares to the Rhode Island Greening is the Northwest Greening.
Rome Apple 	A round, bright red apple with an aromatic, rich flavor when cooked. The Rome is a slightly tart apple that tastes somewhat bland when eaten raw, however when cooked its flavor is enhanced. It makes a good pie and cobbler apple because is holds its texture and shape when baked. This apple is also known as Rome Beauty.
Sonya Apple 	Originating in New Zealand, this variety of apple has been developed with a distinctive shape and flavor. The Sonya Apple is taller in shape than a traditional apple, standing more upright rather than round and stout. Covered with light red shading over a golden yellow and green background, the flesh of the Sonya Apple matures into a very sweet flavor with very little acidity. Sonya Apples are descendants of the Gala and Red Delicious varieties, with a flavor similar to the Golden or Red Delicious apples, but sweeter.

Southern Rose™ Apple 	A variety of apple that has a fully dark red outer skin with firm white inner meat. Southern Rose was discovered in New Zealand as a chance seedling and shares many characteristics with Braeburn. Also known as "Red Braeburn," Southern Rose's flavor is tangy-sweet. It is a good apple for eating out of hand and for use in fresh-cut trays, since it resists browning naturally.
Spartan Apple 	An all-purpose medium sized apple that is a cross between the McIntosh and the Newtown apple. It is dark red in color over a greenish yellow background and has a crisp, white flesh providing a uniquely sweet flavor. It is a great snacking apple and cooks up soft, making it excellent for applesauce.
Splendor Apple 	A fruit that comes from the Pacific Rose family of apples, this apple is a cross between a Red Dougherty and a Golden Delicious. It is a larger apple with a pinkish-red colored thin skin and a juicy, white inner flesh. The apple provides a distinctively sweet flavor and is often considered to be a dessert apple. It bruises easily, but does store very well. It can also be referred to as Splendor Apple.
Spy Gold Apple 	Large in size, this apple was developed as a cross between a Northern Spy and a Golden Delicious apple. Similar in size to a Northern Spy, which is slightly larger than a Golden Delicious, the Spy Gold matures into a predominately red coloring with a gold background. Beneath the outer skin is a yellowish-white flesh that is firm and crisp in texture. The Spy Gold provides the sweet tasting flavor of a Golden Delicious and the juicy consistency of a Northern Spy. It is a good apple for pies, baking and snacking. This apple may also

	be referred to as a Spygold, Spigold, or Spi Gold.
Stayman Apple 	A medium to large red apple with skin that has areas of slight russeting. The Stayman has a juicy off-white flesh that is firm but tender and provides a sweet but slightly tart, wine-like flavor. It is a good apple for pies, sauces or eating raw. This apple keeps well in refrigerated storage. The Stayman apple is a milder offspring of the Winesap apple but is slightly larger and more elongated. Also referred to as a Stayman Winesap.
Sunrise Apple 	A medium to large sized apple that has a light yellow background that is striped with red, with more red on the exposed side. Its crisp, juicy white flesh and wonderful sweet, tart flavor makes it an excellent snacking apple. It is also a good baking apple for pies and desserts.
Sweet 16 Apple 	A medium size apple that has a red with yellow streaked outer skin and a cream colored fine textured flesh. This apple has a very sweet flavor with high sugar content and is considered a good apple for baking sauces or eating raw.
Wealthy Apple 	An older variety of apple that is able to endure and grow well in colder climates. The wealthy is a medium to large size apple with a greenish-yellow and red outer skin covering a white to cream colored flesh. This apple provides crisp textured meat with a tart flavor. It is a variety that is often used for pies, cakes, sauces, juice, and cider.
Winesap Apple	A small deep red apple with a juicy, yet firm, greenish yellow flesh and a tart, wine-like flavor. The Winesap apple is a good eating apple or served in salads. It

	is an all-purpose apple, which holds its flavor when cooked in sauces and pies. It is also often used to make cider.
Wolf River Apple 	A very old hearty apple variety that is large in size, commonly weighing over a pound. This apple is golden green to bright red in color with a firm cream-colored flesh that provides a rich sweet flavor. The firm flesh makes it an excellent apple for sauce, for drying, for baking, and eating out of hand.
York Imperial Apple 	An apple variety characterized by its red skin, which contains streaks of yellow and russet specks and its flattened oblong shape. It has a creamy white flesh that is crisp and coarse textured. The York Imperial has a flavor that is sweet yet slightly tart. It is an excellent choice for baked desserts or for dishes cooked on the stovetop, since it holds its shape and flavor well when cooked. It is most often available during the winter months.
Zestar Apple 	A variety of apple that grows well in cooler climates, Zestar apples are harvested late in the summer season. It is bright red with greenish yellow coloring, medium sized, with a crisp white grainy flesh that is very juicy and sweet in flavor. The sweet spicy flavor of this apple makes it an excellent one for snacking, as well as for baking and sauces. Store it in refrigerated areas to keep for approximately 6 to 8 weeks.

APPENDIX III: Dietary Value of the Pome Fruits:

Apple:

Nutritional aspects: Dietary value, per 100 gram edible portion contains: Water 85%, Calories 56, Protein 0.2%, Fat 0.6%, Carbohydrates 14%, Crude Fiber 3-4%, Vitamin A 1.8% of US RDA (Percent of recommended daily allowance set by FDA, assuming a 154 lb male adult, 2700 calories per day), Thiamin, B1 2.1% of US RDA, Riboflavin, B2 1.2% of US RDA, Niacin 0.6% of US RDA, Vitamin C 16% of US RDA, Calcium 0.9% of US RDA, Phosphorus 1.2% of US RDA, Iron 3.0% of US RDA, Potassium 2.3% of US RDA.

Apple Dietary value, per 100 gram edible portion

Water (%)	85
Calories	56
Protein (%)	0.2
Fat (%)	0.6
Carbohydrates (%)	14
Crude Fiber (%)	3-4
	% of US RDA*
Vitamin A	1.8
Thiamin, B1	2.1
Riboflavin, B2	1.2
Niacin	0.6
Vitamin C	16
Calcium	0.9
Phosphorus	1.2
Iron	3.0
Sodium	---
Potassium	2.3

* Percent of recommended daily allowance set by FDA, assuming a 154 lb male adult, 2700 calories per day.

Apple Nutrition Facts Continued:

Nutrition Facts

Serving Size 1 large apple (242g / 8 oz.)

Amount Per Serving

Calories 130 Calories from Fat 0

	% Daily Value**
Total Fat 0g	**0%**
Saturated Fat 0g	**0%**
Trans Fat 0g	**0%**
Cholesterol 0mg	**0%**
Sodium 0mg	**0%**
Potassium 260mg	**7%**
Total Carbohydrate 34g	**11%**
Dietary Fiber 5g	**20%**
Sugars 25g	
Protein 1g	

Vitamin A 2% • Vitamin C 8%

Calcium 2% • Iron 2%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Apples, raw, with skin (1)

Refuse: 10% Core and stem)

NDB No: 09003 Nutrient values and weights are for edible portion**.** USDA National Nutrient Database for Standard Reference, Release 21 (2008)

Nutrient	Units	Value per 100 grams
Proximate		
Water	g	85.56
Energy	kcal	52
Energy	kJ	218

Protein	g	0.26
Total lipid (fat)	g	0.17
Ash	g	0.19
Carbohydrate, by difference	g	13.81
Fiber, total dietary	g	2.4
Sugars, total	g	10.39
Sucrose	g	2.07
Glucose (dextrose)	g	2.43
Fructose	g	5.90
Starch	g	0.05
Minerals		
Calcium, Ca	mg	6
Iron, Fe	mg	0.12
Magnesium, Mg	mg	5
Phosphorus, P	mg	11
Potassium, K	mg	107
Sodium, Na	mg	1
Zinc, Zn	mg	0.04
Copper, Cu	mg	0.027
Manganese, Mn	mg	0.035
Fluoride, F	mcg	3.3
Vitamins		
Vitamin C, total ascorbic acid	mg	4.6
Thiamin	mg	0.017
Riboflavin	mg	0.026
Niacin	mg	0.091
Pantothenic acid	mg	0.061
Vitamin B-6	mg	0.041
Folate, total	mcg	3
Folate, food	mcg	3
Folate, DFE	mcg_DFE	3
Choline, total	mg	3.4
Betaine	mg	0.1
Vitamin B-12	mcg	0.00
Vitamin B-12, added	mcg	0.00
Vitamin A, RAE	mcg_RAE	3
Carotene, beta	mcg	27
Cryptoxanthin, beta	mcg	11
Vitamin A, IU	IU	54
Lutein + zeaxanthin	mcg	29
Vitamin E (alpha-tocopherol)	mg	0.18
Vitamin K (phylloquinone)	mcg	2.2
Lipids		
Fatty acids, total saturated	g	0.028
14:0	g	0.001
16:0	g	0.024

18:0	g	0.003
Fatty acids, total monounsaturated	g	0.007
18:1 undifferentiated	g	0.007
Fatty acids, total polyunsaturated	g	0.051
18:2 undifferentiated	g	0.043
18:3 undifferentiated	g	0.009
Phytosterols	mg	12
Amino acids		
Tryptophan	g	0.001
Threonine	g	0.006
Isoleucine	g	0.006
Leucine	g	0.013
Lysine	g	0.012
Methionine	g	0.001
Cystine	g	0.001
Phenylalanine	g	0.006
Tyrosine	g	0.001
Valine	g	0.012
Arginine	g	0.006
Histidine	g	0.005
Alanine	g	0.011
Aspartic acid	g	0.070
Glutamic acid	g	0.025
Glycine	g	0.009
Proline	g	0.006
Serine	g	0.010

Footnotes:
1 Based on analytical data for red delicious, golden delicious, gala, granny smith, and fuji varieties.

Apple juice, canned or bottled, unsweetened, with added ascorbic acid

Refuse: 0%

NDB No: 09400 Nutrient values and weights are for edible portion. USDA National Nutrient Database for Standard Reference, Release 21 (2008)

Nutrient	Units	Value per 100 grams
Proximate		
Water	g	88.24
Energy	kcal	46
Energy	kJ	191
Protein	g	0.10
Total lipid (fat)	g	0.13
Ash	g	0.23

Carbohydrate, by difference	g	11.30
Fiber, total dietary	g	0.2
Sugars, total	g	9.62
Sucrose	g	1.26
Glucose (dextrose)	g	2.63
Fructose	g	5.73
Minerals		
Calcium, Ca	mg	8
Iron, Fe	mg	0.12
Magnesium, Mg	mg	5
Phosphorus, P	mg	7
Potassium, K	mg	101
Sodium, Na	mg	4
Zinc, Zn	mg	0.02
Copper, Cu	mg	0.012
Manganese, Mn	mg	0.074
Fluoride, F	mcg	39.1
Selenium, Se	mcg	0.1
Vitamins		
Vitamin C, total ascorbic acid	mg	38.5
Thiamin	mg	0.021
Riboflavin	mg	0.017
Niacin	mg	0.073
Pantothenic acid	mg	0.049
Vitamin B-6	mg	0.018
Choline, total	mg	1.8
Betaine	mg	0.1
Vitamin B-12	mcg	0.00
Vitamin B-12, added	mcg	0.00
Vitamin A, IU	IU	1
Lutein + zeaxanthin	mcg	16
Vitamin E (alpha-tocopherol)	mg	0.01
Vitamin E, added	mg	0.00
Lipids		
Fatty acids, total saturated	g	0.022
14:0	g	0.001
16:0	g	0.018
18:0	g	0.002
Fatty acids, total monounsaturated	g	0.006
18:1 undifferentiated	g	0.005
Fatty acids, total polyunsaturated	g	0.039
18:2 undifferentiated	g	0.033
18:3 undifferentiated	g	0.007

Applesauce, canned, sweetened, with salt

Refuse: 0%

NDB No: 09402 Nutrient values and weights are for edible portion. USDA National Nutrient Database for Standard Reference, Release 21 (2008)

Nutrient	Units	Value per 100 grams
Proximate		
Water	g	79.58
Energy	kcal	76
Energy	kJ	318
Protein	g	0.18
Total lipid (fat)	g	0.18
Ash	g	0.14
Carbohydrate, by difference	g	19.91
Fiber, total dietary	g	1.2
Minerals		
Calcium, Ca	mg	4
Iron, Fe	mg	0.35
Magnesium, Mg	mg	3
Phosphorus, P	mg	7
Potassium, K	mg	61
Sodium, Na	mg	28
Zinc, Zn	mg	0.04
Copper, Cu	mg	0.043
Manganese, Mn	mg	0.075
Selenium, Se	mcg	0.3
Vitamins		
Vitamin C, total ascorbic acid	mg	1.7
Thiamin	mg	0.013
Riboflavin	mg	0.028
Niacin	mg	0.188
Pantothenic acid	mg	0.052
Vitamin B-6	mg	0.026
Folate, total	mcg	1
Folate, food	mcg	1
Folate, DFE	mcg_DFE	1
Vitamin A, RAE	mcg_RAE	1
Vitamin A, IU	IU	11
Lipids		
Fatty acids, total saturated	g	0.030
12:0	g	0.001
14:0	g	0.001
16:0	g	0.025

18:0	g	0.004
Fatty acids, total monounsaturated	g	0.007
18:1 undifferentiated	g	0.007
Fatty acids, total polyunsaturated	g	0.054
18:2 undifferentiated	g	0.045
18:3 undifferentiated	g	0.009
Amino acids		
Tryptophan	g	0.002
Threonine	g	0.007
Isoleucine	g	0.007
Leucine	g	0.011
Lysine	g	0.011
Methionine	g	0.002
Cystine	g	0.002
Phenylalanine	g	0.005
Tyrosine	g	0.003
Valine	g	0.008
Arginine	g	0.006
Histidine	g	0.003
Alanine	g	0.007
Aspartic acid	g	0.032
Glutamic acid	g	0.019
Glycine	g	0.007
Proline	g	0.006
Serine	g	0.007

Apples, dried, sulfured, uncooked
Refuse: 0%

NDB No: 09011. Nutrient values and weights are for edible portion. USDA National Nutrient Database for Standard Reference, Release 21 (2008)

Nutrient	Units	Value per 100 grams
Proximates		
Water	g	31.76
Energy	kcal	243
Energy	kJ	1017
Protein	g	0.93
Total lipid (fat)	g	0.32
Ash	g	1.10
Carbohydrate, by difference	g	65.89
Fiber, total dietary	g	8.7

Sugars, total	g	57.19
Minerals		
Calcium, Ca	mg	14
Iron, Fe	mg	1.40
Magnesium, Mg	mg	16
Phosphorus, P	mg	38
Potassium, K	mg	450
Sodium, Na	mg	87
Zinc, Zn	mg	0.20
Copper, Cu	mg	0.191
Manganese, Mn	mg	0.090
Selenium, Se	mcg	1.3
Vitamins		
Vitamin C, total ascorbic acid	mg	3.9
Riboflavin	mg	0.159
Niacin	mg	0.927
Pantothenic acid	mg	0.245
Vitamin B-6	mg	0.125
Choline, total	mg	17.6
Lutein + zeaxanthin	mcg	18
Vitamin E (alpha-tocopherol)	mg	0.53
Tocopherol, beta	mg	0.02
Tocopherol, gamma	mg	0.07
Tocopherol, delta	mg	0.00
Vitamin K (phylloquinone)	mcg	3.0
Lipids		
Fatty acids, total saturated	g	0.052
12:0	g	0.001
14:0	g	0.001
16:0	g	0.043
18:0	g	0.007
Fatty acids, total monounsaturated	g	0.013
16:1 undifferentiated	g	0.001
18:1 undifferentiated	g	0.012
Fatty acids, total polyunsaturated	g	0.093
18:2 undifferentiated	g	0.077
18:3 undifferentiated	g	0.016
Amino acids		
Tryptophan	g	0.009
Threonine	g	0.033
Isoleucine	g	0.037
Leucine	g	0.057
Lysine	g	0.058
Methionine	g	0.009
Cystine	g	0.012
Phenylalanine	g	0.026

Tyrosine	g	0.017
Valine	g	0.043
Arginine	g	0.029
Histidine	g	0.015
Alanine	g	0.033
Aspartic acid	g	0.162
Glutamic acid	g	0.097
Glycine	g	0.037
Proline	g	0.032
Serine	g	0.038

Crabapple

Refuse: **8% (Core and stems)**
NDB No: 09077. Nutrient values and weights are for edible portion. USDA National Nutrient Database for Standard Reference, Release 21 (2008).

Nutrient	Units	Value per 100 grams
Proximates		
Water	g	78.94
Energy	kcal	76
Energy	kJ	318
Protein	g	0.40
Total lipid (fat)	g	0.30
Ash	g	0.42
Carbohydrate, by difference	g	19.95
Minerals		
Calcium, Ca	mg	18
Iron, Fe	mg	0.36
Magnesium, Mg	mg	7
Phosphorus, P	mg	15
Potassium, K	mg	194
Sodium, Na	mg	1
Copper, Cu	mg	0.067
Manganese, Mn	mg	0.115
Vitamins		
Vitamin C, total ascorbic acid	mg	8.0
Thiamin	mg	0.030

Riboflavin	mg	0.020
Niacin	mg	0.100
Lipids		
Fatty acids, total saturated	g	0.048
16:0	g	0.040
Fatty acids, total monounsaturated	g	0.012
18:1 undifferentiated	g	0.011
Fatty acids, total polyunsaturated	g	0.088
18:2 undifferentiated	g	0.073
18:3 undifferentiated	g	0.015

Loquat, raw

Refuse: **35% (Seeds and skin)**
NDB No: 09174. Nutrient values and weights are for edible portion. USDA National Nutrient Database for Standard Reference, Release 21 (2008)

Nutrient	Units	Value per 100 grams
Proximates		
Water	g	86.73
Energy	kcal	47
Energy	kJ	197
Protein	g	0.43
Total lipid (fat)	g	0.20
Ash	g	0.50
Carbohydrate, by difference	g	12.14
Fiber, total dietary	g	1.7
Minerals		
Calcium, Ca	mg	16
Iron, Fe	mg	0.28
Magnesium, Mg	mg	13
Phosphorus, P	mg	27
Potassium, K	mg	266
Sodium, Na	mg	1
Zinc, Zn	mg	0.05
Copper, Cu	mg	0.040
Manganese, Mn	mg	0.148
Selenium, Se	mcg	0.6
Vitamins		
Vitamin C, total ascorbic acid	mg	1.0
Thiamin	mg	0.019

Riboflavin	mg	0.024
Niacin	mg	0.180
Vitamin B-6	mg	0.100
Folate, total	mcg	14
Folic acid	mcg	0
Folate, food	mcg	14
Folate, DFE	mcg_DFE	14
Vitamin A, RAE	mcg_RAE	76
Vitamin A, IU	IU	1528
Lipids		
Fatty acids, total saturated	g	0.040
12:0	g	0.001
14:0	g	0.001
16:0	g	0.032
18:0	g	0.004
Fatty acids, total monounsaturated	g	0.008
18:1 undifferentiated	g	0.008
Fatty acids, total polyunsaturated	g	0.091
18:2 undifferentiated	g	0.077
18:3 undifferentiated	g	0.013
Phytosterols	mg	2
Amino acids		
Tryptophan	g	0.005
Threonine	g	0.015
Isoleucine	g	0.015
Leucine	g	0.026
Lysine	g	0.023
Methionine	g	0.004
Cystine	g	0.006
Phenylalanine	g	0.014
Tyrosine	g	0.013
Valine	g	0.021
Arginine	g	0.014
Histidine	g	0.007
Alanine	g	0.024
Aspartic acid	g	0.058
Glutamic acid	g	0.061
Glycine	g	0.020
Proline	g	0.027
Serine	g	0.020

Loquat

Dietary value, per 100 gram edible portion:

Water (%)	ca. 90
Calories	168
Protein (%)	1.4
Fat (%)	0.7
Carbohydrates (%)	43
Crude Fiber (%)	? (high)

	% of US RDA*
Vitamin A	47
Vitamin C	6.7
Calcium	8.8
Phosphorus	15.8
Iron	14
Sodium	---
Potassium	26

* Percent of recommended daily allowance set by FDA, assuming a 154 lb male adult, 2700 calories per day.

Mayhaw:

Nutrition Facts

Serving Size: 20g

Amount per Serving

Calories 45	Calories from Fat 0
	% Daily Value *
Total Fat 0g	0%
Saturated Fat 0g	0%
Sodium 0mg	0%
Total Carbohydrate 12g	4%
Dietary Fiber 0g	0%
Sugars 12g	
Protein	0%

Pear:

Pears offer a natural, quick source of energy, due largely to high amounts of two monosaccharides: fructose and glucose, plus levulose, the sweetest of known natural sugars, found to a greater extent in fresh pears than in any other fruit. Carbohydrates make up 98% of the energy provided by a pear. Pears do not have to be peeled because their skin is tender and an additional source of fiber. A medium sized pear provides 4 grams of fiber, or 16% of the recommended daily value.

Fresh pears offer dietary fiber, much of it in the form of pectin. A pear weighing 166 grams provides 2.32 grams of crude fiber, and 4 grams of dietary fiber, of which 41% is pectin. Fresh pears also offer potassium; 210 mg in a medium size pear. Fresh pears contain Vitamin C. One medium size pear provides 7 mg or 10% of the RDA for Vitamin C.

Pear, raw

Refuse: 10% (Stem, core and seeds)
NDB No: 09252. Nutrient values and weights are for edible portion. USDA National Nutrient Database for Standard Reference, Release 21 (2008)

Nutrient	Units	Value per 100 grams
Proximates		
Water	g	83.71
Energy	kcal	58
Energy	kJ	242
Protein	g	0.38
Total lipid (fat)	g	0.12
Ash	g	0.33
Carbohydrate, by difference	g	15.46
Fiber, total dietary	g	3.1
Sugars, total	g	9.80
Sucrose	g	0.78
Glucose (dextrose)	g	2.76
Fructose	g	6.23
Lactose	g	0.01
Maltose	g	0.01
Minerals		
Calcium, Ca	mg	9
Iron, Fe	mg	0.17
Magnesium, Mg	mg	7
Phosphorus, P	mg	11
Potassium, K	mg	119
Sodium, Na	mg	1
Zinc, Zn	mg	0.10
Copper, Cu	mg	0.082
Manganese, Mn	mg	0.049
Fluoride, F	mcg	2.2
Selenium, Se	mcg	0.1

Vitamins		
Vitamin C, total ascorbic acid	mg	4.2
Thiamin	mg	0.012
Riboflavin	mg	0.025
Niacin	mg	0.157
Pantothenic acid	mg	0.048
Vitamin B-6	mg	0.028
Folate, total	mcg	7
Folate, food	mcg	7
Folate, DFE	mcg_DFE	7
Choline, total	mg	5.1
Betaine	mg	0.2
Vitamin A, RAE	mcg_RAE	1
Carotene, beta	mcg	13
Cryptoxanthin, beta	mcg	2
Vitamin A, IU	IU	23
Lutein + zeaxanthin	mcg	45
Vitamin E (alpha-tocopherol)	mg	0.12
Tocopherol, gamma	mg	0.03
Vitamin K (phylloquinone)	mcg	4.5
Lipids		
Fatty acids, total saturated	g	0.006
16:0	g	0.005
18:0	g	0.001
Fatty acids, total monounsaturated	g	0.026
16:1 undifferentiated	g	0.001
18:1 undifferentiated	g	0.025
Fatty acids, total polyunsaturated	g	0.029
18:2 undifferentiated	g	0.029
Phytosterols	mg	8
Amino acids		
Tryptophan	g	0.002
Threonine	g	0.011
Isoleucine	g	0.011
Leucine	g	0.019
Lysine	g	0.017
Methionine	g	0.002
Cystine	g	0.002
Phenylalanine	g	0.011
Tyrosine	g	0.002
Valine	g	0.017
Arginine	g	0.010
Histidine	g	0.002
Alanine	g	0.014
Aspartic acid	g	0.105
Glutamic acid	g	0.030

Glycine	g	0.013
Proline	g	0.021
Serine	g	0.015

Pear, Asian, raw

Refuse: 9% (Core and stem)
NDB No: 09340. Nutrient values and weights are for edible portion. USDA National Nutrient Database for Standard Reference, Release 21 (2008)

Nutrient	Units	Value per 100 grams
Proximates		
Water	g	88.25
Energy	kcal	42
Energy	kJ	176
Protein	g	0.50
Total lipid (fat)	g	0.23
Ash	g	0.37
Carbohydrate, by difference	g	10.65
Fiber, total dietary	g	3.6
Sugars, total	g	7.05
Minerals		
Calcium, Ca	mg	4
Magnesium, Mg	mg	8
Phosphorus, P	mg	11
Potassium, K	mg	121
Selenium, Se	mcg	0.1
Vitamins		
Vitamin C, total ascorbic acid	mg	3.8
Thiamin	mg	0.009
Riboflavin	mg	0.010
Niacin	mg	0.219
Pantothenic acid	mg	0.070
Vitamin B-6	mg	0.022
Folate, total	mcg	8
Lutein + zeaxanthin	mcg	50
Vitamin E (alpha-tocopherol)	mg	0.12
Vitamin K (phylloquinone)	mcg	4.5
Lipids		
Fatty acids, total saturated	g	0.012
16:0	g	0.010

18:0	g	0.002
Fatty acids, total monounsaturated	g	0.049
16:1 undifferentiated	g	0.001
18:1 undifferentiated	g	0.047
20:1	g	0.001
Fatty acids, total polyunsaturated	g	0.055
18:2 undifferentiated	g	0.054
Amino acids		
Tryptophan	g	0.005
Threonine	g	0.013
Isoleucine	g	0.014
Leucine	g	0.025
Lysine	g	0.017
Phenylalanine	g	0.013
Tyrosine	g	0.004
Valine	g	0.018
Arginine	g	0.009
Histidine	g	0.005
Alanine	g	0.017
Aspartic acid	g	0.098
Glutamic acid	g	0.036
Glycine	g	0.014
Proline	g	0.016
Serine	g	0.018

Quince:

Nutritional aspects: The seed contains 20% mucilage and 15% fatty oils. The fruit is rich in pectin, which is said to protect the body against radiation. The leaves contain 11% tannin. Per 100g edible portion contains: water 83.8%, Vitamin A 40 IU, protein 0.4 g, Vitamin B1 (thiamin) 0.02 mg, fat 0.1 g, Vitamin B2 (Riboflavin) 0.03 mg, carbohydrate 15.3 g, Vitamin C 15-20 mg, calcium 11 mg, phosphorus 17 mg, iron 0.7 mg, potassium 197 mg, sodium 4 mg

Quince, raw

Refuse: 39% (Core, seeds, and parings)

NDB No: 09296. Nutrient values and weights are per 100 g edible portion. USDA National Nutrient Database for Standard Reference, Release 21 (2008)

Nutrient	Units	Value per 100 grams
Proximates		
Water	g	83.80
Energy	kcal	57

Energy	kJ	238
Protein	g	0.40
Total lipid (fat)	g	0.10
Ash	g	0.40
Carbohydrate, by difference	g	15.30
Fiber, total dietary	g	1.9
Minerals		
Calcium, Ca	mg	11
Iron, Fe	mg	0.70
Magnesium, Mg	mg	8
Phosphorus, P	mg	17
Potassium, K	mg	197
Sodium, Na	mg	4
Zinc, Zn	mg	0.04
Copper, Cu	mg	0.130
Selenium, Se	mcg	0.6
Vitamins		
Vitamin C, total ascorbic acid	mg	15.0
Thiamin	mg	0.020
Riboflavin	mg	0.030
Niacin	mg	0.200
Pantothenic acid	mg	0.081
Vitamin B-6	mg	0.040
Folate, total	mcg	3
Folate, food	mcg	3
Folate, DFE	mcg_DFE	3
Vitamin A, RAE	mcg_RAE	2
Vitamin A, IU	IU	40
Lipids		
Fatty acids, total saturated	g	0.010
16:0	g	0.007
18:0	g	0.002
Fatty acids, total monounsaturated	g	0.036
18:1 undifferentiated	g	0.036
Fatty acids, total polyunsaturated	g	0.050
18:2 undifferentiated	g	0.049