ADP GUIDE TO

POST HARVEST HANDLING OF APPLES

Robert Belding Ph.D

August 2006

INDEX

1.0 INTRODUCTION

Regrettably, there are no magic formulas for avoiding disease and damage to apples, and no single step which will help a grower to achieve good quality fruit. Instead there are very many, maybe hundreds, of tiny steps and improvements in production and handling, each of which can be relatively easily implemented. If a grower and his staff take all of these tiny steps, a dramatic improvement in fruit quality will occur.

This ADP Guide to Post Harvest Handling of Apples looks at the major issues that affect the post harvest quality of apples, including:

1. Selection of variety

The phrase 'Post Harvest Handling' is something of a misleading statement because, as every grower knows, post harvest handling starts not at harvest, but at the very beginning of production, when the varieties of fruits and vegetables to be produced are selected.

The choice of apple variety – with natural characteristics for long storage life and resistance to transport damage – are as important as any work or process that is carried out in an orchard before harvest, during the harvest, or whilst handling or storing crops after harvest.

2. Orchard Management

Apple quality and the length of post harvest or marketing life of apples, (ie the number of weeks apples will remain in good condition), are both significantly affected by production activities that take place in orchards in the months and weeks before harvest.

3. Fruit Management During and after Harvest

Gentle care and attention provided for apples during harvest, transport, storage and packing is crucial to:

- the length of good quality marketing life that can be achieved,
- the ease with which fruit can be sold
- the price which it will achieve.

It is important to understand that it is not possible to improve apple fruit quality in storage:

Quality Must be Achieved in the Orchard and Maintained after Harvest.

2.0 FRUIT QUALITY

2.1 Varietal Characteristics

Global production of apples is extremely high – indeed estimates by the Food and Agricultural Organization (FAO) suggest that in 2005 over 62 million MT were produced. Clearly in order to sell for premium (highest) prices, it is essential that growers produce the best quality fruit - to international market standards - and then ensure that they maintain the quality after harvest, during storage and delivery.

The grower needs to take the viewpoint of a business, determining which varieties/ characteristics of apples are the most demanded by target markets, can be grown and handled to a high standard, and will bring the greatest financial returns for his investment.

Aspects of fruit quality to be considered include:

- Visual aspects – the color, shape and size of the fruit
- Organoleptic qualities – the taste, texture and aroma
- Freedom from frequent defects – mis-shapes or other physiological problems
- Pest and disease resistance
- Storage life – whether the fruit remains in good condition over a long or short period
- Good resistance to damage during picking, handling and transport
- Ease of production
- Good, reliable yields.

2.2 Cultivar selection

Apple varieties are climate specific, not every variety is suitable for production in Moldova, and growers are advised to create a collection of new or experimental varieties which are market demanded, and that will bring the largest return on investment.

Braeburn Gala Fuji

Currently Braeburn, Fuji, and Gala are excellent apples, but growers should look to the future to see what is increasing in demand. This is extremely difficult to predict accurately, but the widely respected 2006 World Apple Review[1] lists apparent trends for a number of varieties by:

- Percentage of actual production in 2000,
- Preliminary production figures for 2005, and
- Forecast production for 2010 and 2015, along with production rankings (1st, 2nd most important etc), for the same years. See Appendix 1.

[1] Produced by Belrose, Inc Available from the ADP Project

According to the Belrose study, the biggest volume increases in global markets are expected to be for Gala/Royal Gala; and the largest percentage rises in production are anticipated to be for "Honeycrisp", "Pink Lady" and "Jazz".

These last three are newer varieties of sought after apples that can command the highest prices. "Honeycrisp" and "Jazz" are patented and royalties are paid per box sold not per tree planted. "Pink Lady" is not a cultivar, but a patented grade standard of the cultivar "Cripps Pink". The use of the name "Pink Lady" is restricted on international markets, and royalties are paid by metric ton of production, not per tree.

Information on the characteristics of the different apple varieties is available at the Export Moldova website: http://export.acsa.md

2.3 EU Marketing (Quality) Standards

Globally, many countries set legally enforced Quality Standards for fruits and vegetables. In order to be sold in those countries, fruits and vegetables need to meet the standards.

In the EU, Marketing Standards (previously known as Quality Standards) require suppliers to assess and grade apples based on a number of criteria, including:

- freedom from damage (including damage by pests, diseases, bruising and physiological disorders)
- cleanliness
- shape
- color
- flavor/taste
- grading and uniformity of grading
- labeling and packaging.

Summary EU Marketing Standards are attached at Appendix 4 and are also available on the internet, in 20 EU languages at:
http://eur-lex.europa.eu/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=32004R0085&model=guicheti

3.0. ORCHARD MANAGEMENT FOR GOOD POST HARVEST QUALITY

Having tested and selected good varieties/cultivars of apples which produce the best qualities demanded by international markets, and which are also resistant to handling and transport damage, the grower can add significantly to the varieties' good post harvest characteristics by improved production methods.

Many improved production methods have a direct **beneficial** effect on the post harvest quality of apples. These actions include:

3.1 Thin fruit to reduce fruit numbers on branches

Thinning fruit has many benefits that are essential for achieving good international standards of fruit quality:

a Fruit Color:

An important rule for making a good quality, well colored apple is Sun Exposure during growth. Red skin color is a direct result of sun exposure. If fruit is covered by a leaf or touching another fruit, or too deep in the canopy of the tree, good color does not develop.

Thinning developing fruit, at a very early stage, to only one fruit per flower cluster will result in separated fruit on the tree, helping to maximize good sun exposure, and therefore color, on all surfaces.

b. Fruit Size:

Thinning the developing fruit to only one fruit per flower cluster reduces competition between fruit (competition for light, nutrients and water), which will allow each individual fruit to achieve the desired, large, fruit size.

Allowing too many fruit to develop will result in small, poor quality fruit. In the USA, growers try to achieve only one fruit for every two flower clusters.

c. Balanced Vegetative/Fruit Growth:

Another reason to thin fruit and reduce fruit numbers is to maintain a balanced fruit load on the tree.

Poor management of fruit numbers can allow the balance of fruit to shoot growth to become uneven, resulting in nutrients and energy that should be going to fruit being diverted into vegetative growth. And excessive vegetative growth causes :

- Shading problems, reducing fruit quality
- Reduced plant energy for flower buds for the following years' fruit crop
- Weak flower buds – which cannot result in high quality fruit
- Vigorous growth preferentially diverts nutrients from fruits to new shoot tissue. This is a natural survival mechanism for the tree, but the diversion of the nutrient calcium from fruit tissue lowers fruit quality.

3.2 Water management for improved fruit size

Since apples are primarily water, maintaining an adequate water supply at the proper time is important. Fruit cell division only takes place during the four weeks after bloom. After that period, the existing cells do not multiply in number, but the cells are then filled.

If the tree is under stress during the cell division phase, the potential fruit size will be reduced. Likewise, if too much or too little water is present during the period prior to harvest (approximately 6 weeks before harvest) fruit size or fruit quality will be affected. Too much water pre-harvest lowers fruit quality.

Drip irrigation is useful in providing optimal amounts of water (and fertilizer) consistently throughout the season for healthy fruit development.

3.3 Calcium Nutrition

Calcium is extremely important to fruit quality, and particularly important to the post harvest quality of fruit, in the following ways:

a. Fruit Disorders

Low levels of calcium in fruit are the major cause of the development of bitter pit/black spot disorder, and corky tissue.

b. Fruit Firmness

The cell walls of apple flesh are connected together by pectin, activated by calcium, which forms a critically important component of the cell walls of the fruit flesh. The level of calcium in the fruit contributes to both the integrity and the durability of fruit tissue, including firmness. After varietal/genetic characteristics, the level of calcium in a fruit is the most important factor governing fruit firmness.

And fruit firmness is a very common consumer requirement for fresh apples. Major international buyers are strongly influenced by measurements of fruit firmness. Indeed, commercial buyers' selection criteria for apples appear to be: firmness, fruit size, color, consistent quality throughout the shipments, and attractive packaging.

Wholesale buyers frequently
specify the firmness of the fruit they will buy

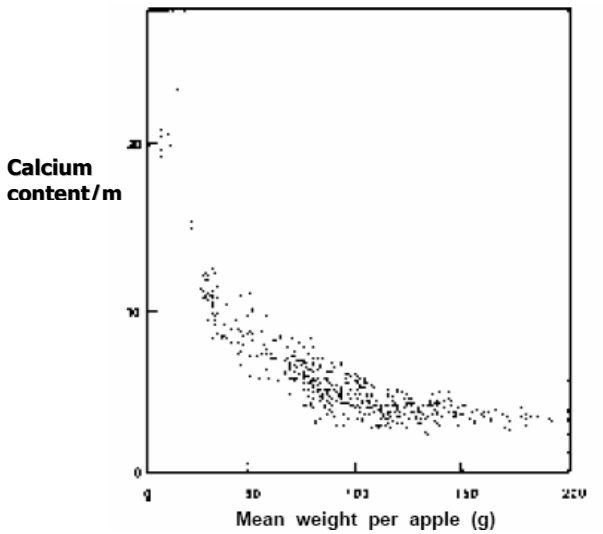
The firmness of fruit is routinely and objectively measured using an instrument called a penetrometer (or Fruit Firmness/Pressure Tester). The tests, which are destructive to fruit, are carried out on samples from consignments of apples, or samples from an orchard, (or a section or block of a large orchard). Fruit firmness is easily and accurately measured in terms of lbs or gms of force required to penetrate the fruit flesh.

Photograph 1: A Penetrometer (Fruit Firmness/Pressure Tester), used for assessing fruit firmness/softness.

The more calcium fruit contains, the longer the fruit can be stored and still maintain good quality/firmness. Low fruit calcium reduces both firmness and storage life.

Naturally occurring levels of calcium vary considerably, depending on soil characteristics, production season, etc. Research indicates that fruit size is also important. As shown in Figure 1 fruit calcium content mg/100g fruit, naturally decreases as apple size increases, which means that the larger fruits desired by markets naturally have lower calcium content per 100g of fresh weight, and are therefore at risk of becoming soft and senescent.

Figure 1: Graphs showing fruit calcium content of apples, vs. size of apple



The importance of calcium cannot be overlooked. More calcium can be made available to fruits by thinning fruit numbers, and managing vegetative growth so that it does not become excessive.

c. Improving Fruit Quality and Post Harvest Life by using Orchard Sprays of Calcium

Physiologically, calcium has restricted movement inside a plant, particularly at the points of uptake into the roots, and during transport within the plant.

For this reason growers worldwide frequently apply/spray solutions of soluble calcium directly onto leaves and fruit, to help increase the levels present in fruit.

However, before considering a program of calcium sprays, cultural practices used in orchards must be evaluated, since in any specific orchard one factor could lead to low fruit calcium levels. Five factors to consider include:

1. Soil conditions (pH and nutrient balance)
2. Water deficient soil conditions
3. Calcium applications to the soil
4. Moderating tree vigor
5. Moderating fruit density/numbers

Growers are first urged to investigate whether any inadequacies exist with regard to these factors, and to amend production practices where necessary (provided the cost of the control practices is less than losses from the disorders).

d. Calcium sprays

During the past 20 years much research has been conducted on calcium nutrition of apples in South Africa, Australia, New Zealand, England, and the United States, focusing primarily on calcium products, rates and timings of applications that will minimize[2] the incidence of low-calcium physiological disorders in apples –ie. bitter pit and corking.

The major portion of the research has been conducted on Golden Delicious and York Imperial apples. However, recommendations developed from research in Pennsylvania USA have effectively controlled corking and bitter pitting in nearly all varieties.
Based on this research, growers are advised to implement a comprehensive calcium management program to reduce corking and bitter pit disorders, and to improve fruit firmness and post harvest life.

[2] Only rarely can this problem be totally eliminated

Calcium spray programs should be used in co-operation with regular analysis of fruit calcium levels during the season, and in particular at the end of the season, to determine whether fruits will store well. When taking fruit for analysis, it is important not to:

- Take more than one fruit from each tree
- Sample damaged or diseased fruit
- Sample heavily shaded fruit
- Sample unusually large or small fruit

The effective use of calcium chloride tree sprays may be the most cost-effective and fastest cultural practice for reducing low-calcium physiological disorders in apples. Recommendations given by the author to growers in Pennsylvania, are given below as guidelines for Moldovan Growers and researchers. ***It must be remembered that in Moldova, all agrochemicals must be applied in accordance with Moldovan legislation.***

In Pennsylvania, it is recommended to apply 15 to 55 kilos of calcium chloride, **divided between six to eight foliar sprays,** ie 2 – 7kg per spray application, per hectare per season. Calcium in the form of calcium chloride is recommended because of its proven effectiveness and lower cost.

- ***15–22 kilos per hectare per year****:* This is the lowest rate that should be used. It will give some control of bitter pitting and corking, will cause no leaf burning/damage, and will probably not enhance storage life of the fruit.
- ***22–34 kilos per hectare per year****:* This rate should give good control of preharvest physiological disorders and probably should be the standard rate where these disorders are chronic problems. It will not cause any significant leaf injury and will probably not enhance the storage life of the fruit.
- ***35–45 kilos per hectare per year****:* This rate should give excellent control of corking and bitter pitting and should be the intermediate rate for Pennsylvania. It may somewhat enhance the storage potential of apples and should result in almost no leaf injury.
- ***45–56 kilos per hectare per year****:* This is probably the highest rate of calcium that can be used in Pennsylvania, and should give outstanding control of corking and bitter pit. This rate may result in some slight burning on the edges of the leaves, but it usually does not appear until mid-September or October. This rate may enhance the storage life of the fruit.

In addition to calcium chloride, other products that supply calcium are available, and are recommended at rates that supply lower amounts of calcium. These products may be beneficial when only small amounts of calcium are needed to correct any deficiency. To evaluate other materials effectively, growers should compare the cost per kilo of calcium present in the formulation, and the quantity needed to achieve an equivalent rate of calcium to the recommended15 to 55 kilos of calcium chloride per hectare per season.

e. <u>Applying calcium chloride sprays</u>

Time of application: Calcium chlorine can be included in all cover sprays. However, if calcium chloride is to be applied with other products (eg micro-nutrient foliar fertilizers):

1. Check compatibility of the two (or more) products with their manufacturers
2. Never mix two products in a small volume of water before adding to the tank, (mixing in a small volume could cause precipitation of one or more products).

Liters per hectare: There are no restrictions on water rates; sprays with as little as 90 gallons (311Litres) per hectare have been effective.

***Compatibility**:* At the rates recommended, calcium chloride may be mixed with spray oil, with wettable powder (WP) formulations, or with emulsifiable concentrate (EC) formulations of the more common fruit pesticides. However, compatibility of materials other than calcium chloride is uncertain, and growers should either check the label or product manufacturer for information, or conduct a compatibility test in a small jar, to ensure that precipitation does not occur.

***Leaf injury**:* Some leaf injury may occur from calcium chloride sprays following wet, cool springs or hot, dry summers. When injury is noticed, reduce calcium chloride to one-half the rate in the next spray or delete calcium chloride from the cover sprays until one-half inch of rain has fallen.

***Equipment**:* Calcium chloride can corrode some types of spray equipment. Few problems have occurred if sprayers and tractors are rinsed after use, or with newer sprayers made of stainless steel or other metals that are rust resistant, fiberglass, or various plastics.

Table 1: **Foliar calcium recommendations**
from The Pennsylvania State University http://tfpg.cas.psu.edu/202.htm

Problem nutrient	Material	Annual rate/ha [a]	Timing [b]	Comments
Calcium	Calcium chloride (77-80% $CaCl_2$)	15-55 kg divided into several sprays to be applied during the season	1-7	Do not use calcium nitrate. Do not premix calcium chloride with other products, unless this is approved by each product manufacturers

[a] Commercial formulation
[b] 1 - 7 = 1st through 7th cover sprays,
Other materials may be suitable, but always ask for independent test results on products not known to be effective.

4.0 HARVESTING AT OPTIMUM FRUIT MATURITY

4.1 Fruit Maturity

Ensuring that fruit is harvested at the optimal maturity stage will maximum the possibilities of achieving top quality fruit in store, with the best potential for long storage life.

It is essential to understand that maturity and ripeness are two very different stages of an apples' life.

1. **Mature Fruit** is defined as fruit that has reached a point in it's development when it becomes physiologically capable of ripening naturally on its own – even though the fruit is not yet ready to eat, it is sufficiently well developed that after harvest it's starches will turn to sugars, the fruit will become juicy, skin color will change etc.

   Fruits harvested before they are mature will be small, they will never ripen properly – they will be sour, taste starchy, have poor color and tough texture, low sugars, lack variety flavor and be more susceptible to storage disorders. (Edwards 1998).

   For apples, the main physiological change indicating an apple's level of maturity is the fruit's internal production of the plant hormone **Ethylene (C_2H_4)** - a naturally occurring hormone which, when levels reach 1ppm, triggers the cascade of biochemical reactions involved in ripening.

2 **Ripe Fruit** Botanically, ripe fruit is fruit which is in a physiological state to disperse viable seeds. Gastronomically, we generally consider that ripe fruit is fruit which as reached its optimum eating qualities – usually juicy, with soft, sweet and aromatic flesh and good skin color.

4.2 Fruit Ripening

Ethylene produced when the fruit reaches maturity causes fruit to ripen, ie to soften, produce volatile compounds (aroma and flavors), convert starch to sugars, develop skin color, and breakdown green chlorophyll.

Fruits, such as apples, which produce ethylene in their ripening process are called climacteric fruits. Once climacteric fruit have begun to ripen, the ripening process is impossible to stop. However, the process can be slowed, for example by cooling the fruit, and by controlling the atmosphere around the fruit. For every 10 degrees centigrade that fruit is cooled, the ripening rate will be reduced by half, but it is important not to store fruit at less than –1.0 to 2.0 degrees centigrade – depending on variety.

The length of storage life achievable will depend on:

- the fruit variety/cultivar
- how ripe the fruit is when harvested - Less ripe fruit will store longer, and in better condition, than riper fruit (however, even fruit to be stored and marketed, months or up to a year later, must be harvested at the mature state).
- how quickly and efficiently the fruit is cooled - storage life is reduced 10 to 20 days for every 24hrs delay in getting the fruit to cold storage.
- good temperature control during storage
- controlling the atmosphere around the fruit, in particular the levels of carbon dioxide and oxygen in the air

Fruit destined to be sold immediately after harvest can be harvested after ripening on the tree, and thus will have the best opportunity to gain fruit size and color before harvest. However, care should be taken to avoid picking fruit too late in the ripening phases, as over-ripe fruit can lead to excessive fruit drop in the orchard and internal physiological breakdown and disorders of fruit flesh, resulting in poor quality fruit, which is easily bruised and has a short shelf or marketing life.

Generally fruit from vigorous young trees, weak trees, or light cropping trees will reach maturity and ripen early and should go to the fresh market. It should be kept separate from mature, heavy cropping trees.

4.3 Tests for Fruit Maturity

Determining that fruit has reached maturity and has started to ripen, is a critical step in the harvesting period. The difference between an immature and over-mature fruit is usually only 7-14 days – depending on the variety, area, the season, weather and cultural practices (pruning, fertilizers applications etc).

Researchers can monitor fruit internal ethylene production in the laboratory (and the field), to indicate stages of maturity, but this is not practical for farmers.

Other indicators of maturity used to select harvest dates include:

- the starch-Iodine test)
- brix (soluble sugar) levels)
- fruit firmness)

These are destructive tests. Fruit tested cannot be marketed. It is important to carry out tests on a sample of fruit which accurately represents the orchard being assess.

- counting the number of days after full bloom
- seed coat (pericarp) color
- skin color

a. Starch Iodine (SI) Test for Maturity

This is a reliable method for determining maturity for most apple varieties and is the easiest indicator of apple maturity. As an apple ripens the starch naturally accumulated in the fruit turns to sugar.

This test measures the level of conversion of starch to sugar,[3] which is correlated with ethylene evolution.

Examples of Starch Iodine (SI) Charts are shown in Appendix 2. As a rule, fruit with an SI reading of 3-4, when compared with a SI chart, are suitable for long-term CA storage, apples with a reading of 4-6 are best for short term CA storage, and fruit reading 6 or more should be placed in regular cold storage or marketed immediately.

Equipment for SI testing consists of a one liter hand-operated spray bottle filled with SI solution, a pocket knife, and a Starch Index chart.

The iodine should be prepared freshly each harvest season, and stored in a dark container during the season, as it is sensitive to light. A pharmacist can easily make the solution as follows:

1. Dissolve 8.8 grams of potassium iodide in about 30ml of warm water. Gently stir the solution until the potassium iodide is properly dissolved.
2 Add 2.2 grams of iodine crystals. Shake the mixture until the crystals are thoroughly dissolved.
3. Dilute this mixture with water to make 1.0 litres of test solution. Mix well.

WARNING: Iodine is a very poisonous chemical. The iodine solution should be properly labeled "POISON" with the name IODINE SOLUTION, and it must be kept in a locked cupboard, away from children and pets. Apples used in the test should not be fed to any animals, or used in composting. In case of ingestion of either iodine or iodine treated apples, induce vomiting and consult a physician immediately.

It is very important to begin sampling and testing the fruit, two weeks before the anticipated harvest, to obtain a baseline level for fruit maturity.

The procedure should be carried out before noon, and is simple:

- Pick a sample of apples in an advanced stage, that appear ready to harvest, based on their size, color, dates after full bloom and taste/sweetness
- Cut fruits in half, horizontally around the 'equator' of the fruits
- Spray the halved fruit with the SI solution; the surface should be well wetted. After approximately one minute the areas with starch will react with the iodine and turn blue-black and the sugar areas will stay white
- Wait for 1 – 1.5 minutes and make a reading by comparing the starch sugar ratios with SI charts.
- Generally in an orchard there is an increase of one starch unit every 5 days, although this can be accelerated in hot weather.

Sample SI charts for McIntosh, Empire, Jonathan, and Golden Delicious can be found in Appendix 2 of this Guide.

b. <u>Soluble solids</u>

Measuring soluble solids is another way to assess the conversion of starch to sugar. Soluble solids are measured with a hand held refractometer.

Photograph 2: Refractometer – Side view

Refractometer – View from top

[3] This test can be performed on apples that were pressure tested (see Fruit Firmness below).

To use a refractometer:

- cut a slice of an apple between the fruit stem and flower scar.
- lift the clear plastic cover of the refractometer, and squeeze apple juice on to the lens – without dropping pulp onto the lens.
- carefully lower the plastic cover onto the juice – ensuring that a layer of pulp-free juice is trapped on the lens, without trapping any air bubbles.
- Look though the black eye piece – towards a gentle light source.
- A scale becomes visible, (which can be focused by twisting the black eye piece). The percentage sugars can be read from the scale.
- Testing the refractometer with plain water should give a reading of zero.
- Between tests/after use, rinse the lens and lens cover with water, and dry with a scratch free cloth or paper.

Table 2: Apple Maturity Guide by Brix level (soluble sugars, measured with a refractometer)

Brix guide	Low	Fair	Good	Excellent
All Varieties	<11	11	12	13
Honeycrisp	<12	12	13	>14

Source: Michigan State University Extension, USA

NOTE: These values are for fruit which are mature and ready to be harvested and placed in store. Fruit to be sold/marketed for consumer sales/eating will be riper with more starch turned to sugar and higher Brix levels, eg 16-17.

c. Fruit Firmness

Fruit firmness - measured in imperial pounds (lbs)[4] or kilos of pressure - is one of the most important quality aspects of an apple. In some years, apple firmness declines faster than in other years - no single factor can result in consistent firmness, and a grower's experience and judgment are important when assessing fruit firmness.

Fruit destined for long term CA storage should have pressures of 15lbs firmness, or higher. CA storage helps maintain fruit firmness, and different levels of oxygen in store have different effects.

Penetrometer

Using a penetrometer to pressure test fruit:

1. Using a fruit peeler, remove two small discs of skin midway between the flower scar and stem on opposite sides of the apple.
2. Hold fruit against a solid surface, (this is most important) then force the plunger head into the center of the pared flesh with a steady continuous pressure until the line marked on the plunger head is level with the fruit surface (this takes one to two seconds).

Record the reading and then continue to pressure test apples until a minimum of 10 to 12 fruit have been tested. Calculate an average fruit pressure from these samples, for the sample period. Reset

Table 3: Values in lbs of pressure measured with a Penetrometer

Variety	Potential CA storage period		
	Short term	Mid Term	Long Term
Braeburn	16	17	18
Cortland	14	15	16
Empire	14	15	16
Fuji	16	17	18
Gala	16	17	18
Golden Delicious	15	16	17
Honeycrisp	15	16	17
Idared	14	15	16
Jonagold	15	16	17
Jonathan	14	15	16
McIntosh	14	15	16
Mutsu	16	17	18
Red Delicious	16	17	18
Rome	15	16	17
Spartan	17	18	19
Source: Michigan State University Extension, USA			

[4] 2.2lbs = 1kg

the tester after each reading and calibrate it at least once a year/in accordance with the manufacturer's recommendations.

d. Days from Bloom

The period from full bloom to actual harvest is fairly constant for any given variety. However, when temperature records are kept and heat units are calculated, a better estimate is obtained. The average number of days from full bloom to maturity in five apple varieties are as follows:

Variety	**Days To Maturity**
Jonathan	135-145
Red Delicious	145-155
Golden Delicious	150-160
Winesap	160-175
Rome Beauty	165-175

e. Seed Color

Apple seeds turn brown or black as they mature inside the fruit. An average rating for seed color can be made as follows: seeds all white; brown color beginning to show on sharp end of seeds; 1/4 of seed with brown color; 1/2 area of seed brown; 3/4 area of seed brown and all of seed brown. Record the average for each apple assessed. Seeds from mature fruit will be dark brown to black.

f. Skin color

Multiple picking may have to be made for some varieties of apples, in order to obtain consistent fruit quality. The guide in this case will be background color of the fruit.

5.0 MINIMISING DISEASE AND DAMAGE DURING STORAGE

There are no magic formulas for avoiding disease and damage to apples. There are only very many tiny steps - improvements which can be made - with each step contributing to a reduction in post harvest bruising. If everyone in an apple harvesting and handling organization implements all the tiny steps to improvement, the overall effect will be the production of first class apples.

5.1 Field sanitation

It is important to recognize that disease spores are always present in the orchard during the growing season, but the fruit only becomes susceptible to many diseases during the last few weeks prior to harvest.

Once fruit is infected there is no effective way to eliminate the infection. However, the incidence of rots on trees and stored apples can be significantly reduced by good cultural/sanitation processes at all stages in fruit production and handling:

- Prune to form open light, trees and orchards with good air movement, and to eliminate low hanging branches, which can put the fruit in contact with grass.
- Weeds and grass should be managed to ensure good airflow around fruit trees, and to reduce the development of moist humid conditions that promote the development of apple diseases.
- Weeds and grass should not be allowed to grow under trees because they are reservoirs for fungal spores which can be released when the grass is disturbed, and in humid conditions.
- Grass in rows between trees should be weak, and must not be cut/disturbed when climate conditions are good for disease-causing spores to germinate and grow.

- Remove diseased wood and mummified fruits during winter and summer pruning
- Avoiding overhead irrigation
- Design and implement an orchard fungicide spray program, targeted against specific known rot risks.
- Thin to avoid bunches of fruit which can attract damaging pests eg tortrix, blastobasis; and grazing by insects
- Maintaining good pest control programs to avoid fruit damage.
- Apply mulches - dust in the orchard should be minimized to prevent the spread of soil-borne spores.
- Optimize fruit mineral content, high nitrogen and low calcium levels promote decay and poor fruit quality. Calcium levels in fruit should be high to help fruit resist fungal invasion.
- Fruit should be harvested at optimum maturity, but not optimum ripeness, because riper fruit is more susceptible to disease.

5.2 Preventing decay in store

- Ensure the best cultural practices are operating in the field, during production, harvest and transport.
- Penicillium expansum (blue mould) spores can enter apples through their stems, leading to stem end decay. Although generally not present in new facilities, P. expansum spores increase year after year, and inoculums survive from one year to the next on field bins and on storage floors and walls. A single badly contaminated wooden bin can carry more than 2 billion spores.

  Plastic bins carry fewer spores, but still carry millions Spores are spread from bins:
  - during handling operations (especially where water floatation systems are used),
  - by air currents
  - by workers
  - by insects
  - from fruit to fruit
- Sanitation provides the only option for reducing losses, and must be integrated throughout the entire post harvest operation. The following systems should be implemented by apple growers, storage operators and packinghouses, prior to harvest
  - Sanitize packing house and storage walls and floors during the summer.
  - Sanitize bins, removing all previous years debris, particularly any dried/mummified or rotting fruits.
  - Steam cleaning bins is effective or drenching in a suitable, approved/registered cleaning product.
  - Washing/drenching of fruit spreads spores of P. expansum from bins to fruit wounds and to fruit stems where they can initiate rots. If fruit must be washed/drenched before storage, the fruit drenching water must be clean, (potable), it should contain a food safe sanitizing agent to kill any spores introduced into the water, eg by an infected fruit. The water should be changed regularly and frequent checks carried out to ensure that the sanitizer in the water remains at effective levels.
  - Ideally, avoid wetting fruit after harvest
  - Stack bins off the soil - ideally they should remain on trailers. Field bins should never be stored on the soil because their bases will become contaminated with soil, and then when contaminated field bins are stacked one on top of another in the cold store, the soil will dry and fall/be shaken off the base of the bins, contaminating apples in bins below.
  - Fork lift drivers must be trained to lift bins without pushing forklift prongs into soil, in order to ensure that the base of bins do not become contaminated with soil from the forklift prongs.

5.3 Bruising

Technically, bruises are caused by applying force on the fruit:

- Force created by drop impacts (the most common cause of bruising)
- Force created by compression – squeezing/compressing fruit eg in overfull containers

Bruises do not heal and they greatly reduce the marketability and value of fruit. Indeed, in some markets, bruised fruit cannot be sold.

Some cultivars of apples are more susceptible to bruising than others - but no variety is immune. Red Delicious has a reputation that it will resist bruising., but this is only partially true. Simple tests were carried out in the USA, which involved peeling several thousand fruit after packing. Numerous small bruises were found in fruit flesh that could not be seen through the skin. Dr. Gary Hyde (WSU) determined that the bruise susceptibility of Red Delicious was actually greater than that of Golden Delicious. The belief that Golden Delicious is more susceptible stems from the fact that it discolors more easily, and bruises are more visible.

Another standardized bruise study in the UK ranked Gala and Jonagold more susceptible to bruising than Golden. The portion of the apple with green skin bruised more easily than the portion with red color, and large fruit bruise more easily than smaller fruit.

Some causes of bruising include: thinning bruising (the result of lack of care when fruit is being thinned in spring), and fruit dropping through trees. However, the overwhelming majority of bruising injury occurs during the harvest, packing or transport of fruit – that is during and after harvest. In one USA study, rough filling of an unpadded field bin resulted in 89% bruised fruit; compared to gentle filling which bruised 28% of the apples

An objective ADP Project assessment and measurement of impacts during apple harvesting and transport to cold stores was made on five Moldovan farms in 2006, using an electronic Techmark® impact recording device. Information at http://www.techmark-inc.com/impact.asp

This electronic assessment demonstrated that all the potentially harmful impacts experienced by fruit took place in the first two minutes after harvest – ie were caused by the pickers harvesting fruit and transferring it to bulk bins in the fields.

No damaging impacts of any sort were recorded during transportation of apples in bulk bins. This included transportation in the field, by forklift, by lorry in the field, and by lorry on roads during journeys of up to 1.5hrs.

Of a small sample of apples dropped into an empty collecting bucket, two out of three apples were bruised (sometimes more than once) by the fall to the base of the bucket ie by a drop of 30-35cm onto plastic.

The farm where the lowest numbers of impacts were recorded had the best trained harvesting staff, and good harvesting crew supervision. But even on this farm there was still opportunities for minimizing damage to fruit.

Clearly having made substantial investment in growing and producing apples, a serious grower will take steps to ensure that staff are not allowed to mistreat and damage fruit during the harvesting and packing process.

5.4 Design of Harvesting System by Management

Management must design harvesting systems, which should include, but are not limited to, the following:

1. Identification of the optimum harvesting stage for each variety/orchard of apples, and dissemination of information to field staff, to help them identify fruit at the optimum stage for harvest.
2. Ensure workers understand they should not pick wet or very cold apples – which bruise easily. Apples should be allowed to dry or warm before starting harvest.
3. Design of a harvesting plan/system that will ensure minimum handling of fruit. There should be no repeated transfer of apples from container to container/bag to bag. Fruit should be placed in bag/container, and then moved directly and carefully to field bins.

Photograph 3: Soft sided picking sack

4. All picking equipment should be designed to reduce damage. Ideally staff should be provided with picking sacks with soft bases and sides to prevent damage to fruit. Picking sacks which have wide shoulder straps, leave workers with both hands free, meaning better picking and less worker tiredness. Tired workers cannot be efficient workers.
5. Where specifically designed picking buckets with soft sides and bases are not available, plastic buckets can be used, but these should be lined on the base with circles of impact absorbing material –dense plastic or rubber foam material, or plastic bubble wrap cut to fit the base. The pads and buckets must be kept clean and sanitized to prevent the build up of disease/fungal spores which will infect and rot the apples.
6. Harvesting staff should be provided with lightweight ladders, if necessary, to help them reach high fruit. Allowing staff to climb trees will result in poor harvesting, bruised fruits, and damage to trees and developing fruit buds for the following years fruit.
7. Fallen apples (accidentally dropped or knocked to the floor) placed in field bins for storage will be bruised, and will probably rot during storage. If 5% of apples stored are damaged/ of low quality/value or unmarketable, costs of storage of good apples are increased by at least 5%, and 5% of potential sales are lost. Management should ensure that staff totally understand that fallen apples or apples that have had contact with soil or grass should not be picked for storage.
8. Ideally, to prevent hand to fruit contamination, or contamination of picking buckets/bins, fallen apples should be removed by separate picking teams using separate equipment, and they should not be stored.
9. Harvest bins should be designed to limit compression and abrasion injury. Provided that ventilation holes are not covered, field bins can be lined with impact absorbing materials – such as dense plastic or rubber foam or strong plastic bubble film.
10. Field Bins should be maintained in good condition to make stacking simple and easy, minimizing impacts.
11. All fruit held in the field whilst waiting for transport should be stored under shade, to prevent sunburn (sunscold – damage to the skin), and build up of internal heat. When they have been harvested, apples lose their natural cooling system, and left in the sun will heat up internally, losing moisture (and weight) very quickly; they ripen faster and therefore lose quality, storage life and quantity (weight).
12. Covered bins can be stored under the shade of trees. More ideally, the storage and loading area should be covered with dense shade netting or waterproof white tarpaulins, suspended on poles over storage and lorry parking areas. The cover should be high above the stored apples, in order to allow good airflow around the apples and prevent the build up of heat and ethylene gas.

13. The shaded area can be temporary, erected prior to the harvest season, and removed immediately after it, or moved from orchard to orchard, as harvesting progresses
14. For loading areas which are soil based, in dry weather, it is recommended to slightly moisten the area, to prevent dust and dust clouds developing. It is not recommended to make an in-field asphalt site if this is only to be used for 5-6 weeks per year, but it is recommended to encourage grass growth to prevent dust developing (and also soil erosion).
15. It is also strongly recommended that field bins should be placed onto pallets or trailers in the field, not directly onto the soil, to prevent the bases of crates coming into contact with soil, which later falls off the bin base, onto fruit, during stacking or transport of the crates.
16. Fruit must not be held in the field overnight but moved into pre-coolers quickly.
17. Rough roads require slow driving and trucks with numerous large tires to avoid vibration injury.
18. Field bins should be covered with white permeable woven plastic or cotton covers transport, to protect against dust, sun and rainfall etc.

5.5 Staff Training

Staff need to know that apples are as easily damaged as eggs. They must never be dropped, or allowed to fall, not even short distances. This applies to all fruit even fruit destined for juicing – bruised apples do not make good juice, and bad practices used when harvesting fruit for juicing are likely to continue during harvest for storage.

Effective staff supervision is required, to remind staff, as often as necessary, on the correct procedures for picking fruit. In addition, supervisors need training and support from management. Apples poorly handled bruise quickly; a quality controller inspecting and recording the work of picking crews could quickly identify when, where, and who is causing damage/bruising to fruit. Growers might like to consider offering incentives to pickers who pick properly and give disincentives or penalties, (eg lower paying jobs which do not involve handling fruit), to those who cause more bruising than a set maximum.

Formal training sessions should be held immediately prior to the beginning of harvest, with staff taught all requirements for good harvest and handling. Suggested points for training are listed in Appendix 3.

Hygiene - Field toilets and washing facilities

In addition to good harvesting practice, it is important to train harvesting workers on the need for good personal hygiene. Clean hands are preferable to having staff wear gloves, as gloved hands are less sensitive to fruit handling, but harvesters must understand that even though apple picking is a farming occupation, it is important that they keep their hands clean, and fingernails short. Apart from the need for good food hygiene, cleaning of hands is required to ensure that rots are not spread from diseased fruit to good fruit, via dirty hands.

Management can assist this process by ensuring that staff always have good in-field toilet and hand washing facilities available - with warm water, liquid soap (non-perfumed) and paper towels or warm air hand-drying units.

6.0 PACKHOUSE OPERATIONS

6.1 Cooling

Reducing fruit respiration and ethylene production rates is critical to slowing fruit softening and maintaining desirable fruit flesh characteristics. Temperature dramatically affects fruit respiration rates and the rate of all metabolic functions. Degradation of fruit occurs most slowly at 0C and doubles for every 10 C increase in temperature; storage life is reduced by between 4 to 30 days for each day fruit is stored at ambient temperature, with different varieties reacting differently.

- The first method of reducing respiration is by harvesting fruit early in maturity, prior to the fruit's ripening phase.
- The second method is to reduce the temperature of fruit as quickly as possible after harvest.

Table 4 below shows the effect of increasing temperature on respiration and ethylene rates

Table 4: Golden Delicious Respiration rates and Ethylene Production at various temperatures*

	Temperature	0°C (32°F)	5°C (41°F)	10°C (50°F)	20°C (68°F)
Respiration Rate	**ml CO_2/ kg·hr**	3-6	4-8	7-12	15-30
Ethylene Production	**µl/ kg·hr**	1-10	2-25	5-60	20-150

*These rates are for mature, but not ripe fruit. Values increase with increased ripeness.

If warm apples from the orchard are added to a cold store, containing cooled apples, the cold store will warm slightly, and the cooled apples will also warm slightly. Fluctuation of apple temperatures in store is harmful to fruit quality and storage life. If several successive consignments of field warm apples are added to cooled apples, the repeated fluctuation in temperatures leads to increased damage.

Pre-cooling of fruit to remove field heat, before placing fruit into the final bulk cold store, is therefore highly beneficial. Several options are available for pre-cooling including room cooling, forced air cooling and hydro cooling.

a. Room Pre-Cooling

Some growers use **room cooling** which is simply using a normal but empty cold store to chill fruit. The field heat is removed by placing bins in a single layer, widely spread across the empty cold store, allowing good air movement around the fruit to cool it, prior to moving bins of fruit into the long term cold store. Room cooling however, is a relatively slow method of cooling fruit.

b. Forced Air Cooling

Forced air cooling has the advantage of cooling fruit rapidly, which enhances fruit quality/storage life and makes post harvest operations faster.

- A simple system involves placing two lines of apples in a line, in cold store, and covering the tops and 'long' sides of the line with plastic or heavy cotton tarpaulins to form a tunnel; a freestanding, purpose built fan is then placed near one open end of the 'tunnel' creating a negative pressure and drawing cold air through the 'tunnel' of apple bins, cooling the fruit.
- A more complex mobile system involves pallets or bins of fruit, stacked in two rows with a gap between the rows. The space between the pallets, called a "tunnel" is covered by a "curtain" usually made of canvas or heavy duty plastic, and sometimes reinforced/strengthened with slats

sewn into the material from side to side, (about every 0.5m), to prevent the curtain collapsing into the tunnel.

- A permanent system involves including a false wall[5] in the cold store, with a fan behind the false wall, and one or more openings in the wall. Boxes of apples are lined up closely in two rows, one on either side of an opening in the false wall. A plastic or heavy cotton tarpaulin is placed over the two rows of products, and down to the floor at the end of the rows furthest from the wall. The fan pulls cold air from the room through the boxes of apples and into the openings in the false wall; the air then passes through the fan and is recycled into the cold store.

Photograph 4: Pre-Coolers, before and after loading

A permanent pre-cooler showing:

- False wall with two openings
- Fan which draw cold air from the room through the openings in the false wall
- Tarpaulin covers (lifted in the photograph) used to cover the gaps between lines of boxes.

Two lines of boxed fruit

A stacked permanent pre-cooler showing:

- Two lines of cartooned fruit are arranged close to the wall, on either side of an opening in the false wall
- A cover is placed over the top of the two lines of cartons, and over the end of the lines furthest from the wall. Cold air from the room is pulled through ventilation holes in the cartons, into the gap in the false wall, and out through the fan vents above.

A key requirement when using forced air pre-cooling is to ensure that all the air is pulled through the bins or cartons of apples, and that no paths exist for air to enter the false wall, without first passing over the apples. For this reason, openings in pallets on which cartons or bins are stored should be blocked (eg with strong card) during precooling.

Correctly managed, a pre-cooler reduces cooling times and increases the storage life of fresh fruits and vegetables very significantly.

c. Hydrocooling

Hydrocooling is a popular method of cooling fruit in the USA, and is the most rapid. Water is an excellent cooling substrate. Cold water is flushed through bins of apple that arrive from the fields, removing field heat immediately.

However a commercial hydro cooler can cost hundreds of thousands of dollars. The refrigeration system required for a hydro-cooler must be capable of quickly cooling large quantities of water and fruit to zero degrees centigrade.

[5] These false walls are known as plenum walls.

WATER IS THE MOST EFFECTIVE WAY TO SPREAD FRUIT DECAY

In addition a good source of potable water is required, plus a water sterilization system.

It is essential that diseases from one fruit are not spread to all the fruit in the batch via the cooling water. The sterilization system must therefore be carefully managed, preferably computer controlled, and be capable of automatically monitoring and maintaining sterilants at effective levels.

6.2 Cold Storage

When calculating refrigeration cooling capacity for pre-cooling and for cold storage, it is useful to remember that the internal temperature of fruit will need to be close to 0°C, and that apples produce heat in storage as a result of their metabolic activity. Known as heat of respiration, at 0°C, 1 ton of fruit produces 750 BTU of heat, and at 10°C, about 2000 BTU/ton

Depending on variety, apples can be stored for a few days or many months. When loading a cold store the following points need to be considered:

- Only store apples of good quality, which are free of disease and disorders. It is uneconomic to add the cost of storage to poor quality apples.
- Assess storage life of fruit, by field and variety before adding it to the store. In addition to varietal characteristics, criteria which indicate potential long storage life include calcium levels in fruits, and fruit firmness. These should be considered together with the growers' knowledge of the source of the fruit (by orchard) and the year's growing conditions.
- Fruit with the longest storage life should be stacked furthest from the door, fruit with expected shorter life should be closer to the door.
- All bins should be labeled with the fruit variety, source (by orchard or block of a large orchard), and harvest date. Ideally a record/plan should be maintained that lists which apples are stored, and where they are stored, in a coldstore. This information can be vital in identifying bins if problems are found associated with one particular variety/orchard during storage
- Pre-cool fruit before adding them to the cold store and load stores within three days; controlled atmospheres should be achieved within 10 days of the start of loading. Ideally, operators should take and record the temperature of fruit added to the store, (and should also record the temperature of fruit removed from the store). Air temperatures should be recorded in several places within the cold store during the storage period, and monitored carefully. Errors of only a few degrees in temperature will adversely affect fruit quality.
- Consider carefully which bins are to be placed near sampling hatches.
- Optimum storage temperatures differ for different varieties; for this reason where possible, different varieties should be stored in different stores.

In addition to controlling the temperature of a coldstore, relative humidity should be controlled in order to ensure that fruit is not allowed to dehydrate – which causes loss of both quality and product weight. The usual optimum Relative Humidity for apples is 95%.

6.3 Controlled atmosphere

In a controlled atmosphere store, in addition to controlling temperature and humidity the composition of the air is also controlled, in particular the levels of oxygen and carbon dioxide. Lower than normal levels of oxygen slow the fruit respiration rate – inhibiting temperature and ethylene production, and thus maintaining the product at a less ripe state for longer. There are also some advantages in minimizing post harvest disorders in stored fruit, such as Bitter Pit and Storage Scald.

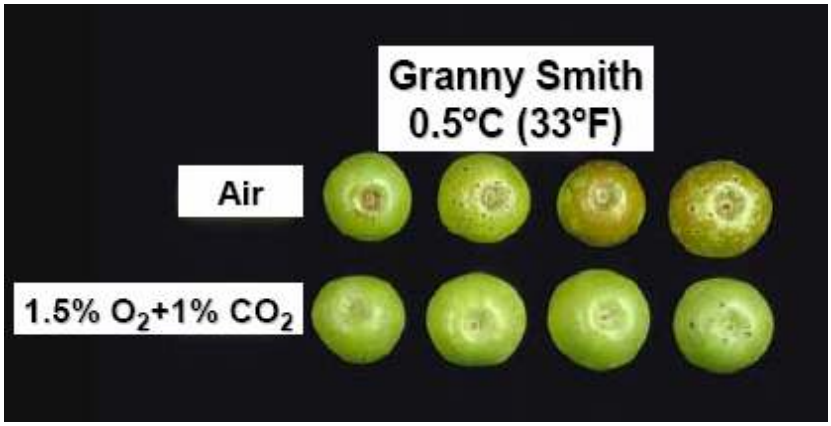


Figure 2: Effects of Controlled Atmosphere Storage Granny Smith Apples stored at 0.5.

Controlled atmosphere stores are more expensive than normal coldstores – because they have to be air tight, with appropriate, airtight seals on doors etc.

The use of controlled atmosphere stores is really quite common practice, but it is highly technical, for example different varieties of apples react differently to differing levels of oxygen/carbon dioxide. Anyone considering these systems should seek individual specialist advice.

6.4 Fruit testing during storage

Samples of apples from every variety, orchard and or block should be set near the sampling hatch of cold stores or CA stores. Testing should occur during the storage season. Firmness is the most accurate method of determining fruit deterioration. Cut each apple to check for internal browning or decay after testing for firmness.

At each test, take 20 apples from each batch. Halve the batch into two and test the first 10 fruits twice using a penetrometer. Keep the second batch of 10 fruit at room temperature for 1 week and pressure test and obtain a lot average. Compare the drop in pressure of the first and second 10 fruits.

In the USA, minimum pressures for Red Delicious are 12lbs (with a 10% tolerance – ie the law allows a maximum of 10 fruits in every 100 to be less than 12lb pressure). Golden Delicious cannot have more than 10% of apples below 10lb pressure.

6.5 Washing

In some countries, apples are washed and waxed before being packed for market. Requirements for washed fruits vary by country and buyers' quality standards. Fruit flumes require appropriate sanitizer to prevent disease spread via the washing water. Specially formulated, (food safe) fruit washing detergents will help remove dirt and external pesticide residues and prepares fruit for waxing if the buyers require it, but there are currently no fruit washing detergents approved for use in Moldova.

Photograph 5: Fruit with washing water passing over (green) washing rollers

6.6 Sorting

Discussions with wholesale markets and major retail buyers clearly show that different grade standards are required by different buyers, and bring differing prices. Sorting fruit to provide buyers

with fruit of consistent quality within the specification required, is essential for ensuring a reasonable selling price.

Minimum standards include grading for size, color, and freedom from defects.

EU Marketing Standards (formerly Quality Standards) set minimum standards and are attached in Appendix 4 (Romanian Language). Most major retailers have more demanding standards, which are usually commercial secrets.

In the packhouse, all systems for handling and emptying of containers should be carefully examined to determine where bruising may occur. Locations where fruit falls from one level to another should be avoided at the design/equipment purchase stage (fruit can pass down gentle slopes, but not fall from one level to another) . All rigid surfaces should be covered with dense, impact absorbing foam, to absorb any impacts that do occur. The foam should be washable, or covered with washable material, to ensure good cleaning and sanitizing of the handling/grading line.

At minimum, the packhouse should have a conveyor/inspection line for fruit (and removal of outgrades), plus size grading equipment.

6.7 Bruising In The Packhouse

There are a number of factors which affect bruising of apples in a packhouse:

- A study on Delicious and Granny Smith determined that the longer they are stored, the more susceptible to bruising they become.
- Packers frequently notice that fruit from certain rooms are more susceptible to bruising than others. This can be traced back to the humidity within the room. Newer rooms are airtight and are run with a minimum number of defrost cycles to minimize moisture loss as a way to prevent shrivel. Fruit from these rooms develop tremendous internal turgor pressure and are very susceptible to bruising.

  Packers have developed various methods of 'conditioning' this fruit to allow for a controlled amount of moisture to be lost by the fruit to reduce the susceptibility to bruising.

  Some methods of conditioning include increasing the number of defrost cycles, opening the doors and increasing the temperature, or placing the bins in a warm room before packing. It is easy to remove a small amount of moisture, but difficult to ensure that all fruit in a bin are affected equally. It is very difficult to re-hydrate shriveled fruit, so caution is advised.
- Temperature at time of bruising—Dr. Hyde, working with Red and Golden Delicious, found the colder the apple the higher the bruise susceptibility.
- Firmness is not a good reflection of bruise susceptibility. In trials carried out in the US, after five weeks in storage fruit had lower firmness levels, but bruise susceptibility did not change.
- The effect of temperature and fruit turgor is less than the effect of the impact force which hits a fruit. It is therefore more important to reduce bruise impact points than to manipulate fruit
- After injury the bruise will be larger if the fruit remains at a higher temperature; another reason to cool fruit rapidly after packing.

In summary—bruise reduction is everyone's business:

- Pickers and packhouse staff must be carefully trained and supervised.
- Bins must be transported carefully within the orchard and to the packinghouse.
- Fruit must be stored carefully to avoid shrivel or excessive turgor.
- Fruit should be conditioned prior to packing.
- The packing line must be carefully monitored; transfer points evaluated and drops eliminated or heavily padded and gentle.

- Fruit acceleration and deceleration must be carefully controlled to avoid impact damage.

6.8 Causes and control of common Post Harvest Storage Rots

Disease	Field Control
Brown Rot *Moniliata Fructigena*	o Prune out cankers o Remove/collect mummified fruits o Good control of Pest and Disease in Field o Avoid Fruit damage o Close supervision of pickers
Black Rot (*Botryosphaeria obtuse*)	o Prune out cankers o Remove/collect mummified fruits o Avoid keeping prunings/cut branches in orchard
Gloeosporium Rot (*Gloeosporium spp)*	o Prune out cankers, dead stubs and die-backs
Phytophthora Rot (*Phytophthora syringae)*	o Maximum width grass strlp o Mulch to cover soil to reduce soil splash o Removing low hanging branches o No soil on bulk bins – including bases of bins (soil from the bases of bins drops onto apples below when bins are stacked)
Nectria Rot *(Nectria galligena*)	o Remove cankers and macerate with prunings
Diaporthe Rot *(Diaporthe permiciosa)*	o Remove cankers, dead and weak wood during pruning
Botrytis *Rots (Botrytis cinerea)*	o Careful inspection of fruit at harvest and discarding affected fruit o Careful picking to avoid wounds o Good control of pest and disease o Avoid soil on bins – or introduction of soil or organic debris such as leaves o Clean bins
Blue Mould *(Penicillium expansum)*	o Careful picking and handling to avoid damage o Good control of pest and disease o Avoid soil on bins – or introduction soil or organic debris such as leaves o Clean bulk bins
Mucor Rot *(Mucro spp*)	o Avoid soil on bins – or introduction of soil or organic debris such as leaves o Clean bulk bins o Removing fallen fruit from orchard after harvest to reduce fungus population soil o Storing dry fruit
Fusarium Rot *(Fusarium spp)*	o Clean bulk bins o Avoid soil on bins – or introduction of soil or organic debris such as leaves o Careful picking to avoid damage

7.0 PACKAGING

The primary purpose of cartons is to protect fruit from damage including bruising, compaction, and vibration. Cartons keep fruit cool, clean, free from bruises, and provide a unit of purchase.

The second primary function of fruit packaging is to ensure that the growers/ packer's name and brand is recognized by the produce buyers. If the name and label/packaging are attractive and are associated with a consistent, good quality product, marketing is much easier. Do not underestimate the value of having your fruit recognized as being of consistently quality!

Packing cartons vary according to different market requirements and the quality of the product. In addition to the large apple cartons filled by count or weight, single or two-layer tray cartons are gaining popularity in some markets.

For Premium products, all cartons should be used in combination with liners/cell trays which hold fruit individually, cushioning the fruit from damage, inhibiting the spread of disease, and improving the presentation/appearance of fruit.

Photographs 6: Packaging Types in Common use.

Apples packed in 3-4 layer wooden crates without cell liners

Apples packed in 2-3 layer trays without cell liners

Apples arranged on cell liners, packed in two layers in trays.

Note: tray has cut-outs (short sides) on long edges, to allow ventilation/air movement during cooling etc.

Apples arranged on cell liners, packed in two layers in 'trays'.

Note: No ventilation holes in the side of the tray.

Apples arranged on cell liners packed in a single layer in 'trays'.

Apples pre-packed into polythene bags, by the supplier, for retail sales.

Depending on post packing cooling methods and customer requirements, cartons should be designed with good ventilation to allow rapid cooling, or non ventilated where apples are cooled prior to packing, remain chilled during the packing process and are rapidly returned to efficient coldstores.

8.0 TRANSPORT

All long distance deliveries should be made in refrigerated transport. Many growers/exporters insist that temperatures are recorded throughout the delivery period, to ensure that fruit arrives in optimum condition. If fruit arrives in poor condition, the temperature records can be vital in settling disputes between transporters and exporters.

It should also be noted that many large retailers insist that all fruit (and vegetables) are transported in refrigerated vehicles, even when the delivery journey is short.

9.0 NEW METHODS OF ETHYLENE MANAGEMENT

As discussed in Section 4.2 above, ethylene is a plant growth hormone which triggers a cascade of biochemical reactions resulting in softening and ripening of fruit, and eventually the loss of quality and commercial value. Limiting the effects of ethylene limits the natural senescence of fruit ,preserving and extending the natural storage life. A first step in ethylene management can be to harvest fruit before production of ethylene begins.

Two further steps involving post harvest treatments of the apples, are described below. Neither of the products mentioned is yet approved for use in Moldova, but that situation may change in the future.

1. **ReTain** (aminoethoxyvinylglycine, manufactured by Valent Biosciences).

Retain is a pre-harvest spray that inhibits the production of ethylene. When used 30 days before anticipated harvest, ReTain inhibits the natural production of ethylene in the fruit. This improves both in-the-field fruit quality and the post harvest storage quality of fruit.

In the field, limiting ethylene helps to prevent fruit from falling from the trees, acting as a stop-drop material. It also delays ripening and senescence so that fruit can be allowed to continue to grow and develop size and sugar before harvest.

In storage, with the production of ethylene inhibited, fruit softening is delayed and fruit will store for a longer period, whilst retaining in good quality. However, in storage, fruit treated with ReTain is sensitive to ethylene produced by other fruit, and will respond by ripening.

2. Smartfresh (1-methylcyclopropene or MCP)

Smartfresh is a gas, used to treat fruit shortly after harvest, that inhibits the receptor sites of ethylene, blocking ethylene from joining with receptor sites in the fruit, and thus prevents ripening. MCP will continue to occupy the binding sites throughout the life of the fruit. If ethylene is present in cold storage, it will not affect MCP treated fruit.

MCP is a simple molecule and it is used in very small concentrations. The material is used in concentrations of 1 ppm or less and must be applied as a gas in a sealed room within one week of harvest. Fruit have dramatically longer storage life and once removed from storage, have a longer shelf life. This is because replacement ethylene binding sites need to be generated and they do not form while fruit are stored at low temperatures.

Trained technicians are the only people allowed to apply the gas, as incorrect application can result in disappointing storage results.

Appendix 1: Variety Trends, Actual Production in 2000, Preliminary Production in 2005, and Forecast Production for 2010 and 2015. (Rank and percent of Total).

Note: Figures exclude production in China

Variety	2000	2005	2010	1015	2000	2005	2010	2015
	Actual %	Prelim. %	Forecast %	Forecast %	Actual Rank	Prelim. Rank	Forecast Rank	Forecast Rank
Red Delicious	22.27	19.50	17.56	16.10	1	1	2	2
Golden Delicious	19.37	19.21	18.59	17.47	2	2	1	1
Gala/Royal Gala	7.45	12.04	12.91	14.17	3	3	3	3
Fuji	4.89	6.48	6.84	7.11	6	4	4	4
Granny Smith	6.45	6.26	6.26	6.20	4	5	5	5
Jonagold	5.24	4.94	4.84	4.74	5	6	6	6
Idared	3.10	4.03	4.03	3.70	7	7	7	7
Braeburn	2.24	2.64	2.82	2.58	8	8	8	8
McIntosh	2.23	1.89	1.75	1.72	9	9	9	10
Elstar	1.72	1.85	1.72	1.64	12	10	10	11
Jonathan	2.16	1.49	1.47	1.32	10	11	12	12
Rome Beauty	1.86	1.40	1.26	1.11	11	12	13	13
Cripps Pink	0.41	1.31	1.62	1.84	23	13	11	9
Cortland	0.84	1.06	0.97	0.87	14	14	14	14
Lobo	0.61	0.86	0.79	0.75	18	15	15	15
Reinette	0.70	0.80	0.78	0.72	16	16	16	16
Gloster	0.75	0.63	0.69	0.62	15	17	17	17
Spartan	0.43	0.58	0.53	0.45	22	18	18	21
Newton	0.52	0.55	0.53	0.53	20	19	18	18
Boskop	0.81	0.54	0.51	0.48	13	20	20	20
Empire	0.45	0.47	0.47	0.50	21	21	21	19
Melrose	0.56	0.44	0.40	0.35	19	22	23	23
Cox's Orange	0.67	0.41	0.41	0.35	17	23	22	23
Tsugaru	0.38	0.40	0.40	0.37	24	24	23	22
Bramley	0.23	0.35	0.32	0.30	28	25	25	25
York	0.34	0.32	0.28	0.27	25	26	26	26
Ohrin	0.25	0.27	0.25	0.25	26	27	27	27
Northern Spy	0.23	0.20	0.19	0.17	28	28	28	29
Stayman	0.25	0.19	0.18	0.16	26	29	29	30
Mutsu	0.14	0.17	0.14	0.13	31	30	31	30
R I Greening	0.15	0.15	0.12	0.11	30	31	32	31
Cameo	0.06	0.14	0.18	0.20	34	32	39	28
Senshu	0.05	0.10	0.09	0.09	36	33	33	32
Hokuto	0.06	0.10	0.09	0.09	34	33	33	32
Ingrid Marie	0.07	0.06	0.06	0.06	32	35	35	34

Source: World Apple Review 2006 Edition, Belrose Inc

Appendix 2: Starch Iodine Testing and Charts

Equipment for SI testing consists of a one liter hand-operated spray bottle filled with SI solution, a pocket knife, and a Starch Index chart.

The iodine should be prepared freshly each harvest season, and stored in a dark container during the season, as it is sensitive to light. A pharmacist can easily make the solution as follows:

1. Dissolve 8.8 grams of potassium iodide in about 30ml of warm water. Gently stir the solution until the potassium iodide is properly dissolved.
2 Add 2.2 grams of iodine crystals. Shake the mixture until the crystals are thoroughly dissolved.
3. Dilute this mixture with water to make 1.0 litres of test solution. Mix well.

WARNING: Iodine is a very poisonous chemical. The iodine solution should be properly labeled "POISON" with the name IODINE SOLUTION, and it must be kept in a locked cupboard, away from children and pets. Apples used in the test should not be fed to any animals, or used in composting. In case of ingestion of either iodine or iodine treated apples, induce vomiting and consult a physician immediately.

It is very important to begin sampling and testing the fruit, two weeks before the anticipated harvest to obtain a baseline level for fruit maturity.

The procedure should be carried out before noon, and is simple:

- Pick a sample of apples in an advanced stage, that appear ready to harvest, based on their size, color, dates after full bloom and taste/sweetness
- Cut fruits horizontally around the 'equator' of the fruits
- Spray the halved fruit with the SI solution; the surface should be well wetted. After approximately one minute the areas with starch will react with the iodine and turn blue-black and the sugar areas will stay white
- Wait for 1 – 1.5minutes and make a reading by comparing the starch sugar ratios with SI charts.
- Generally in an orchard there is an increase of one starch unit every 5 days, although this can be accelerated in hot weather.

After treating with iodine solution, and scoring by a visual comparison with the relevant chart, an average rating of all the apples in a sample should be calculated to determine the fruit maturity rating.

As a rule, fruit with an SI reading of 3-4 are suitable for long-term CA storage, apples with a reading of 4-6 are best for short term CA storage, and fruit reading 6 or more should be placed in regular cold storage or marketed immediately.

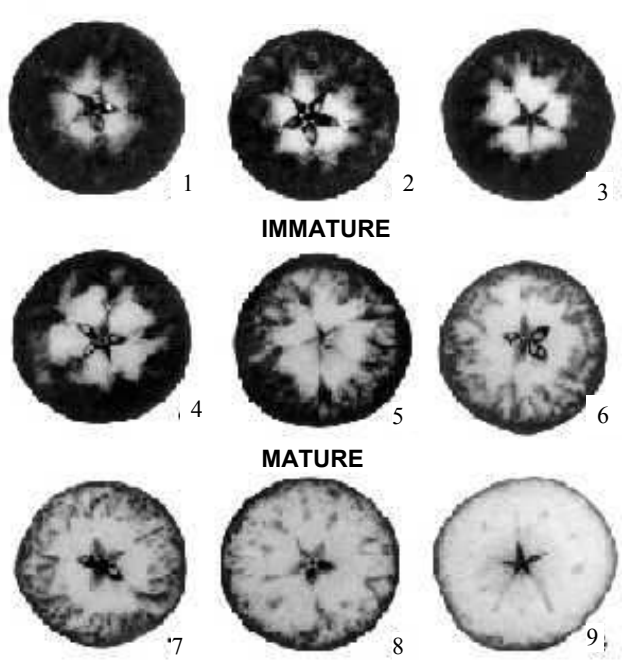
For McIntosh apples harvested for regular Controlled Atmosphere (CA) storage, apples are sufficiently mature when they reach a rating of 4. The use of more efficient cooling equipment, careful handling and rapid transit to the storage can mean that McIntosh apples harvested at a rating of 2.5 to 3.0 are more acceptable for long-term CA storage, or low oxygen storage.

Apples continue to be suitable for regular CA storage as long as they have a rating of 4, 5 or 6. However, the more mature apples should be held for a shorter storage period. Fruit with a rating greater than 6 will have more flavor and a softer texture and be better suited for immediate consumer use. Such fruit may be successfully stored for a short period of time, but should be marketed while their superior eating qualities are still present.

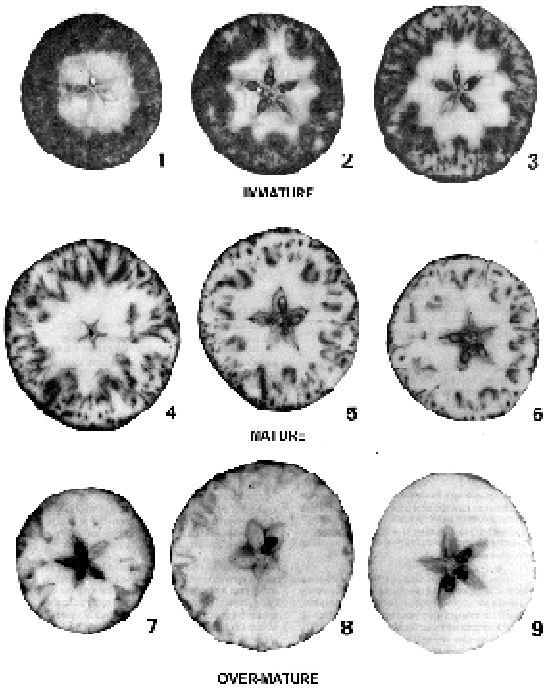
For Red Delicious, the first acceptable harvest for CA storage occurs when the fruit rating reaches 2.5 to 3. Expect a significant variation in the starch/sugar content between different Red Delicious strains. Note that the starch changes in this cultivar are less well defined than in McIntosh.

Note: Dark Areas indicate starch, light areas indicate sugars

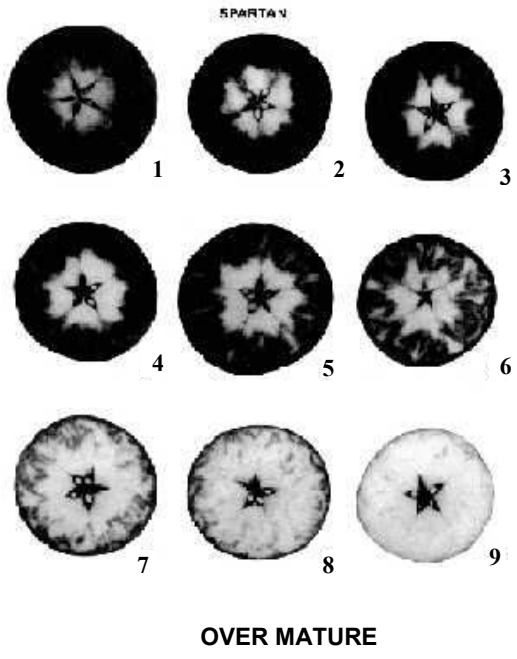
EMPIRE



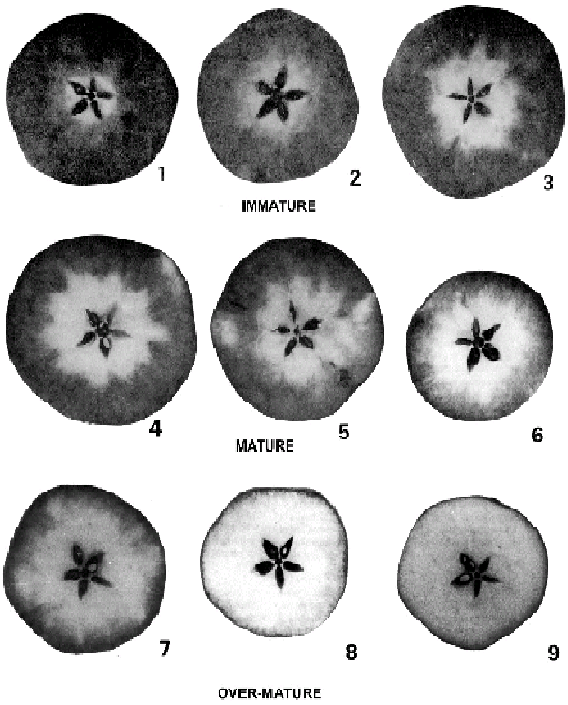
MCINTOSH



SPARTAN



RED DELICIOUS



APPENDIX 3: Suggested Points For Training Harvesting Staff Training

Points for harvesting staff training should include, but are not limited to, the following:

1. Staff should practice good personal hygiene, washing hands before work, after using toilet facilities, or eating, or smoking, or whenever hands become soiled.
2. Staff should keep finger nails short when harvesting, to ensure that they do not damage fruit.
3. Staff should always handle fruit gently to avoid all bruising and wounding, because pathogens often enter fruit through wounds.
4. Staff must be trained on the optimum stage/conditions of maturity for fruit picking, and they must understand that the criteria are different for different varieties of apples.
5. Only good, undamaged fruit should be picked for storage:
    a. Fruit which has punctures – eg bird pecks, insect damage or torn skin should not be picked for the fresh market.
    b. Fruit bruised or damaged on the tree must never be placed in the same containers as fruit for storage or sale. In addition to being bruised, damaged fruit are sources of rots and disease, and also produce larger amounts of ethylene gas, which forces faster ripening and loss of quality in non damaged fruits.
    c. Fruit that has been in contact with the soil, or splashed by the soil, is not suitable for storage or fresh market sales It will rot during transport or storage.
    d. If a fruit falls, it will be bruised. Even if the picker cannot see a bruise, it will be there. Staff must understand that fallen fruit should not placed in picking sacks or bulk bins.
    e. Harvesting teams must be taught to recognize small latent infections. Fruit with these tiny infections should not be harvested for fresh market sales or storage.
6. Harvesting staff should start by picking fruit from the bottom of the tree and then work their way up to the top, even if they only intend to harvest selected fruits - eg those which are at the correct maturity stage - from the tree.
7. Fruit should be picked using the whole hand – including the palm of the hand - and not just the fingertips to pick fruit. Fingertips bruise fruit.
8. Only one apple should be picked at a time
9. Only one apple should be held in the hand at any time.
10. The apple should be harvested by grasping the fruit and turning the fruit to remove it from the branch - with the fruit stem remaining attached.
11. The fruit must NOT be picked by pulling it from the branch.
12. Harvesting staff should be provided with lightweight ladders, if necessary, to help them reach high fruit. Allowing staff to climb trees will result in poor harvesting, bruised fruits, and damage to trees and developing fruit buds for the following years fruit.
13. All fruit should be placed in picking containers without dropping the fruit. Supervisors should see hands being lowered into picking containers as fruit is placed into the container. Pickers dropping fruit - even 10cm - into picking sacks can cause bruising to the fruit they drop, and the fruit already in the container can be bruised by fruit falling on them.
14. In a well managed orchard, there should never be any sounds of fruit falling or rolling. Harvesting should be silent and peaceful.
15. In an orchard where fruit can be heard rolling or falling, fruit are being damaged.
16. Fruit must be carefully transferred from picking containers into bulk bins. There should be no dropping, or rapid movements. Indeed, there should be no sound generated by releasing apples into the bins. This is another operation that should be totally silent.

17. Harvest bins should never be filled higher than the sides of the bins. Apples in overfilled bins are vulnerable to compression damage, and damage by the prongs of forklift trucks when bins are stacked on lorries/into coldstores.
18. Forklift handling of bins can influence impact, and drivers must be trained and supervised to handle fruit bins carefully and gently.

Regulamentul (CE) nr. 85/2004 al Comisiei

din 15 ianuarie 2004

de stabilire **a standardului de comercializare pentru mere**

COMISIA COMUNITĂ□ILOR EUROPENE,

având în vedere Tratatul de instituire a Comunită□ii Europene,

având în vedere Regulamentul (CE) nr. 2200/96 al Consiliului din 28 octombrie 1996 privind organizarea comună a pie□ei în sectorul fructelor □i legumelor[6], în special articolul 2 alineatul (2),

întrucât:

(1) Merele sunt incluse în anexa I la Regulamentul (CE) nr. 2200/96 printre produsele pentru care trebuie adoptate standarde. Regulamentul (CE) nr. 1619/2001 al Comisiei din 6 august 2001 de stabilire a standardului de comercializare pentru mere □i pere □i de modificare a Regulamentului (CEE) nr. 920/89[7] stabile□te un standard comun de comercializare pentru mere □i pere.

(2) Din motive de claritate, Grupul de lucru pentru standardizarea produselor perisabile □i dezvoltarea calită□ii al Comisiei Economice a Organiza□iei Na□iunilor Unite pentru Europa (CEE/ONU) a decis să delimiteze dispozi□iile privind merele de cele referitoare la pere. Pe de altă parte, a decis să actualizeze standardul CEE/ONU FFV-50 privind comercializarea □i controlul calită□ii comerciale a merelor, în ceea ce prive□te dispozi□iile referitoare la calitate □i la mărime. Din motive de transparen□ă pe pia□a mondială, este necesară abrogarea Regulamentului (CE) nr. 1619/2001 □i adoptarea, în consecin□ă, a două noi standarde de comercializare pentru mere, respectiv pere.

(3) Principalul criteriu de maturitate prevăzut de Regulamentul (CE) nr. 1619/2001 este definirea unei dimensiuni minime pentru mere. Având în vedere progresele tehnice din domeniul metodelor de măsurare a fermită□ii □i a con□inutului de zahăr al fructelor, precum □i apari□ia unor noi pie□e de desfacere pentru merele coapte de dimensiuni mici, trebuie redusă dimensiunea minimă a merelor aplicabilă în cadrul Comunită□ii, avându-se grijă, în acela□i timp, prin intermediul unor noi criterii de maturitate ca, de exemplu, con□inutul de zahăr □i fermitatea, ca reducerea dimensiunii minime să nu aibă drept rezultat introducerea pe pia□ă a unor fructe insuficient de coapte □i/sau de dezvoltate.

(4) Deoarece definirea precisă a noilor criterii de maturitate, care să □ină seama de caracteristicile soiurilor în ceea ce prive□te dimensiunea merelor, necesită cercetări mai ample, este oportun să se amâne aplicarea reducerii dimensiunii minime pentru data de 1 august 2005 □i să se prevadă, până la data respectivă, dispozi□ii tranzitorii privind mărimea.

(5) Aplicarea noilor standarde trebuie să elimine de pe pia□ă produsele de calitate nesatisfăcătoare, să orienteze produc□ia în scopul satisfacerii cerin□elor consumatorilor □i să faciliteze rela□iile comerciale pe baza unei concuren□e loiale, contribuind astfel la cre□terea rentabilită□ii produc□iei.

(6) Standardele se aplică în toate etapele de comercializare. Transportul pe distan□e mari, depozitarea pe durată determinată sau diferitele manipulări la care sunt supuse produsele pot atrage după sine diverse alterări care se datorează evolu□iei biologice a produselor sau caracterului lor mai mult sau mai pu□in perisabil. Este recomandabil să se □ină seama de aceste alterări în aplicarea standardelor în etapele de comercializare care urmează după etapa de expediere.

(7) Dat fiind că produsele din categoria „Extra” fac obiectul unei trieri □i condi□ionări extrem de atente, trebuie să se ia în considerare doar diminuarea stării de prospe□ime □i de turgescen□ă a acestora.

(8) Comitetul de gestionare a fructelor □i legumelor proaspete nu a emis un aviz în termenul stabilit de pre□edinte,

ADOPTĂ PREZENTUL REGULAMENT:

Articolul *1*

Standardul de comercializare aplicabil merelor care intră sub inciden□a codului NC ex 0808 10 este prevăzut în anexă.

Standardul se aplică în toate etapele de comercializare, în condi□iile prevăzute de Regulamentul (CE) nr. 2200/96.

Cu toate acestea, în etapele următoare etapei de expediere, produsele pot prezenta, în raport cu cerin□ele standardului:

– o u□oară diminuare a stării de prospe□ime □i de turgescen□ă;

– produsele încadrate în alte categorii decât categoria „Extra” pot prezenta u□oare alterări datorate evolu□iei lor □i caracterului lor mai mult sau mai pu□in perisabil.

Articolul 2

Până la 31 iulie 2005, se aplică următoarele dispozi□ii privind mărimea:

(a) dacă dimensiunea este determinată cu ajutorul diametrului, se impune un diametru minim pentru toate categoriile de fructe, după cum urmează:

	Extra	Categoria I	Categoria II
Soiuri cu fructe mari [(1)]	70 mm	65 mm	65 mm
Alte soiuri	60 mm	55 mm	55 mm

[(1)] Lista neexhaustivă a soiurilor cu fructe mari este prezentată în apendicele la anexă.

(b) dacă dimensiunea este determinată cu ajutorul greută□ii, se impune o greutate minimă pentru toate categoriile de fructe, după cum urmează:

	Extra	Categoria I	Categoria II
Soiuri cu fructe mari [(1)]	140 g	110 g	110 g
Alte soiuri	90 g	80 g	80 g

[(1)] Lista neexhaustivă a soiurilor cu fructe mari este prezentată în apendicele la anexă.

[6] JO L 297, 21.11.1996, p. 1. Regulament modificat ultima dată de Regulamentul (CE) nr. 47/2003 al Comisiei (JO L 7, 11.1.2003, p. 64).

[7] JO L 215, 9.8.2001, p. 3. Regulament modificat de Regulamentul (CE) nr. 46/2003 (JO L 7, 11.1.2003, p. 61).

Articolul 3

Regulamentul (CE) nr. 1619/2001 se abrogă.

Articolul 4

Prezentul regulament intră în vigoare în a douăzecea zi de la data publicării în Jurnalul Oficial al Uniunii Europene.
Paragrafele al doilea și al treilea de la punctul III din anexă se aplică doar de la 1 august 2005.
Prezentul regulament este obligatoriu în toate elementele sale și se aplică direct în toate statele membre.
Adoptat la Bruxelles, 15 ianuarie 2004.
Pentru Comisie
Franz FISCHLER
Membru al Comisiei
Anexă

Standard pentru mere

I. DEFINIȚIA PRODUSULUI

Prezentul standard reglementează merele din soiurile (cultivarele) provenite din Malus domestica Borkh., destinate livrării în stare proaspătă către consumatori, cu excepția merelor destinate transformării industriale.

II. DISPOZIȚII PRIVIND CALITATEA

Standardul are ca obiect definirea calităților pe care trebuie să le prezinte merele după condiționare și ambalare.

A. Caracteristici minime

La toate categoriile, ținând seama de dispozițiile speciale prevăzute pentru fiecare categorie și de toleranțele admise, merele trebuie să fie:

– întregi;
– sănătoase; sunt excluse produsele atinse de putregai sau cu alterări din cauza cărora ar deveni improprii pentru consum;
– curate, practic lipsite de materii străine vizibile;
– practic lipsite de paraziți;
– practic lipsite de atacuri ale paraziților;
– să nu prezinte umiditate exterioară anormală;
– să fie lipsite de mirosuri și/sau gusturi străine.

De asemenea, fructele trebuie să fie culese cu grijă.

Dezvoltarea și starea merelor trebuie să permită:

– continuarea procesului de maturație, pentru a putea atinge gradul de maturitate adecvat în funcție de caracteristicile soiului respectiv [8][9];
– rezistența la transport și manipulare;
– sosirea în condiții satisfăcătoare la locul de destinație.

B. Clasificarea

Merele sunt clasificate în trei categorii definite în cele ce urmează:

(i) Categoria „Extra”

Merele din această categorie trebuie să fie de calitate superioară. Ele trebuie să prezinte forma, mărimea și colorația caracteristice soiului respectiv10 și să aibă atașat un peduncul intact.

Pulpa trebuie să fie lipsită de orice deteriorare.

Merele nu trebuie să prezinte defecte, cu excepția unor foarte mici alterări superficiale la nivelul epidermei, cu condiția ca acestea să nu afecteze aspectul general al produsului, calitatea, conservarea și prezentarea sa în ambalaj.

(ii) Categoria I

Merele din această categorie trebuie să fie de bună calitate. Ele trebuie să prezinte forma, mărimea și colorația caracteristice soiului respectiv (3).

Pulpa trebuie să fie lipsită de orice deteriorare.

Cu toate acestea, merele pot prezenta mici defecte după cum urmează, cu condiția ca acestea să nu afecteze aspectul general al produsului, calitatea, conservarea și prezentarea sa în ambalaj:
– mici defecte de formă;
– mici defecte de dezvoltare;
– mici defecte de colorație;
– mici defecte la nivelul epidermei care nu pot depăși:

[8] În ceea ce privește caracteristicile soiului Fuji și ale mutațiilor sale referitoare la maturitatea la recoltare, fructele afectate de boala miezului sticlos sunt admise, cu condiția ca manifestarea bolii respective să se limiteze la fasciculul fibro-vascular al fiecărui fruct.
9 În acest sens, fructele trebuie să prezinte un conținut solide solubil și un grad de fermitate corespunzătoare.
10 În apendicele la prezentul standard sunt prezentate criteriile privind colorația și gradul de înroșire, precum și o listă neexhaustivă a soiurilor relevante pentru fiecare criteriu.

– lungimea de 2 cm, în cazul defectelor de formă alungită;
– 1 cm2 din suprafa□a totală în cazul celorlalte defecte, cu excep□ia ruginii (Venturia inaequalis), a căror suprafa□ă totală nu poate depă□i 0,25 cm2;
– 1 cm2 din suprafa□a totală în cazul loviturilor u□oare, caz în care epiderma nu trebuie să fie decolorată.

Pedunculul poate lipsi, cu condi□ia ca punctul de rupere să fie curat □i ca epiderma din zona respectivă să nu fie deteriorată.

(iii) Categoria II

Această categorie cuprinde merele care nu se încadrează în categoriile superioare, dar corespund caracteristicilor minime definite în cele ce urmează11.

Pulpa nu trebuie să prezinte defecte esen□iale.

Următoarele defecte sunt admise, cu condi□ia ca fructele să păstreze caracteristicile esen□iale în ceea ce prive□te calitatea, conservarea □i prezentarea:

– defecte de formă;
– defecte de dezvoltare;
– defecte de colora□ie;
– defecte la nivelul epidermei, care nu pot depă□i:
– lungimea de 4 cm în cazul defectelor de formă alungită;
– 2,5 cm2 din suprafa□a totală în cazul altor defecte, cu excep□ia ruginii (Venturia inaequalis), a căror suprafa□ă totală nu poate depă□i 1 cm2;
– u□oare lovituri care nu depă□esc 1,5 cm2 din suprafa□a totală, epiderma putând fi u□or decolorată.

III. DISPOZI□II PRIVIND MĂRIMEA

Mărimea este determinată de diametrul maxim al sec□iunii ecuatoriale sau de greutate.

În cazul în care dimensiunea este determinată cu ajutorul diametrului, se impune un diametru minim pentru toate categoriile de fructe, după cum urmează:

	Extra	Categoria I	Categoria II
Soiuri cu fructe mari (1)	65 mm	60 mm	60 mm
Alte soiuri	60 mm	55 mm	50 mm

(1) Lista neexhaustivă a soiurilor cu fructe mari este prezentată în apendicele la prezentul standard.

În cazul în care dimensiunea este determinată cu ajutorul greută□ii, se impune o greutate minimă pentru toate categoriile de fructe, după cum urmează:

	Extra	Categoria I	Categoria II
Soiuri cu fructe mari (1)	110 g	90 g	90 g
Alte soiuri	90 g	80 g	70 g

(1) Lista neexhaustivă a soiurilor cu fructe mari este prezentată în apendicele la prezentul standard.

Pentru a garanta o dimensiune omogenă a fructelor dintr-un colet:

– pentru fructele măsurate în func□ie de diametru, diferen□a de diametru dintre fructele din acela□i colet este limitată la:

– 5 mm, pentru fructele din categoria „Extra” □i fructele din categoriile I □i II prezentate în straturi suprapuse12;
– 10 mm, pentru fructele din categoria I, prezentate în vrac în coletul sau ambalajul în care sunt comercializate13.
– pentru fructele măsurate în func□ie de greutate, diferen□a de greutate dintre fructele din acela□i colet este limitată la:
– 20 % din greutatea medie a fructelor din colet, pentru fructele din categoria „Extra” □i fructele din categoriile I □i II prezentate în straturi suprapuse;
– 25 % din greutatea medie a fructelor din colet, pentru fructele din categoria I prezentate în vrac în coletul sau ambalajul în care sunt comercializate.

Nu este prevăzută o mărime omogenă pentru fructele din categoria II prezentate în vrac în coletul sau ambalajul în care sunt comercializate.

IV. DISPOZI□II PRIVIND TOLERAN□ELE

Sunt admise toleran□e privind calitatea □i mărimea pentru fiecare colet cu produse care nu sunt în conformitate cu cerin□ele categoriei indicate.

A. Toleran□e privind calitatea

(i) Categoria „Extra”

Aproximativ 5 % din numărul sau din greutatea merelor care nu corespund caracteristicilor categoriei respective, dar sunt în conformitate cu caracteristicile categoriei I sau sunt admise, în mod excep□ional, în toleran□ele pentru această categorie.

(ii) Categoria I

11 În apendicele la prezentul standard sunt prezentate criteriile privind colora□ia □i gradul de înro□ire, precum □i o listă neexhaustivă a soiurilor relevante pentru fiecare criteriu.

12 Cu toate acestea, pentru merele din soiurile Bramley’s Seedling (Bramley, Triomphe de Kiel) □i Horneburger diferen□a de diametru poate atinge 10 mm.

13 Cu toate acestea, pentru merele din soiurile Bramley’s Seedling (Bramley, Triomphe de Kiel) □i Horneburger diferen□a de diametru poate atinge 20 mm.

Aproximativ 10 % din numărul sau din greutatea merelor care nu corespund caracteristicilor categoriei, dar sunt în conformitate cu caracteristicile categoriei II sau sunt admise, în mod excep□ional, în toleran□ele pentru această categorie.

(iii) Categoria II

Aproximativ 10 % din numărul sau din greutatea merelor care nu corespund caracteristicilor categoriei □i nici caracteristicilor minime, cu excep□ia fructelor atinse de putregai sau de alterări din cauza cărora devin improprii pentru consum.

În cadrul acestei toleran□e, se poate admite un procent de maximum 2 % din numărul sau din greutatea fructelor care prezintă următoarele defecte:

– atacuri grave ale bolilor care dau anumitor regiuni din fructe un aspect sticlos sau de plută;
– mici leziuni sau fisuri necicatrizate;
– urme foarte mici de putregai;
– prezen□a unor parazi□i vii în fruct □i/sau alterarea pulpei din cauza parazi□ilor.

B. Toleran□e privind mărimea

Pentru toate categoriile:

10 % din numărul sau din greutatea merelor care au mărimea imediat inferioară sau superioară mărimii men□ionate pe colet înregistrând, în cazul fructelor cu cea mai mică mărime admisă, o varia□ie maximă de:

– 5 mm sub diametrul minim, în cazul în care mărimea este determinată cu ajutorul diametrului;
– 10 g sub greutatea minimă, în cazul în care mărimea este determinată cu ajutorul greută□ii.

V. DISPOZI□II PRIVIND PREZENTAREA

A. Omogenitatea

Con□inutul fiecărui colet trebuie să fie omogen □i să con□ină numai mere de aceea□i origine, din acela□i soi, de aceea□i calitate sau mărime (dacă se determină mărimea), în aceea□i fază de dezvoltare.

De asemenea, pentru categoria „Extra”, se impune omogenitatea din punctul de vedere al colora□iei.

Ambalajele în care sunt puse merele pentru vânzare, având o greutate netă de maximum 5 kg, pot con□ine amestecuri de mere din diverse soiuri, cu rezerva ca acestea să fie omogene în ceea ce prive□te calitatea □i, pentru fiecare soi prezent, originea, mărimea (în cazul în care se determină mărimea) □i faza de dezvoltare.

Prin derogare de la dispozi□iile anterioare de la prezentul punct, produsele reglementate de prezentul regulament pot fi amestecate, în ambalaje de comercializare cu greutatea mai mică sau egală cu trei kilograme, cu fructe □i legume proaspete din specii diferite, în condi□iile prevăzute de Regulamentul (CE) nr. 48/2003 al Comisiei[14].

Partea aparentă a con□inutului coletului trebuie să fie reprezentativă pentru întregul con□inut.

B. Condi□ionarea

Merele trebuie condi□ionate astfel încât să se asigure o protec□ie adecvată a produsului. În special, ambalajele de comercializare având o greutate netă de peste 3 kg trebuie să fie suficient de rigide pentru a proteja produsul în mod adecvat.

Materialele utilizate în interiorul coletelor trebuie să fie noi, curate □i confec□ionate din materiale care să nu producă alterări externe sau interne ale produsului. Este autorizată utilizarea materialelor, în special a hârtiei sau timbrelor care con□in indica□ii comerciale, cu condi□ia ca imprimarea □i etichetarea să fie realizate cu cerneală sau lipici, netoxice.

În colete nu trebuie să existe corpuri străine.

C. Prezentarea

Fructele din categoria „Extra” trebuie ambalate în straturi suprapuse.

VI. DISPOZI□II PRIVIND MARCAJUL

Fiecare colet trebuie să con□ină, în caractere grupate pe aceea□i parte, lizibile, de ne□ters □i vizibile din exterior, următoarele indica□ii:

A. **Identificarea**

Ambalatorul □i/sau expeditorul: numele □i adresa sau identificarea simbolică eliberată sau recunoscută de un serviciu oficial. Cu toate acestea, în cazul în care se utilizează un cod (identificare simbolică), men□iunea „ambalator □i/sau expeditor (sau o abreviere echivalentă)” trebuie să apară lângă acest cod (identificare simbolică).

B. **Natura produsului**

– „mere”, în cazul în care con□inutul nu este vizibil din exterior;
– denumirea soiului;
– în cazul ambalajelor de comercializare care con□in un amestec de soiuri diferite de mere, indicarea fiecărui soi prezent în ambalaj.

C. Originea produsului

□ara de origine □i, eventual, zona de produc□ie sau denumirea na□ională, regională sau locală

– în cazul unui ambalaj de comercializare care con□in un amestec de soiuri diferite de mere de origini diferite, indicarea fiecăreia dintre □ările de origine ale fructelor respective trebuie să apară în imediata apropiere a soiului în cauză.

D. Caracteristici comerciale

[14] JO L 7, 11.1.2003, p. 65.

– categoria;
– mărimea sau, pentru fructele prezentate în straturi suprapuse, numărul de bucă□i.

În cazul în care identificarea are loc pe baza mărimii, aceasta este indicată:

(a) pentru fructele pentru care există norme privind omogenitatea, prin diametrul minim □i maxim sau prin greutatea minimă □i maximă;

(b) pentru fructele pentru care nu există norme privind omogenitatea, prin diametrul sau greutatea celui mai mic fruct din colet, urmate de expresiile „□i peste” sau „□i +” sau o denumire echivalentă sau, după caz, diametrul sau greutatea celui mai mare fruct din colet.

E. Marca oficială de control (facultativă)

Apendice

1. **CRITERII DE COLORA□IE, GRUPE DE COLORA□IE □I CODURI**

Grupa de colora□ie	A (soiuri ro□ii)	B (soiuri cu colora□ie mixt-ro□ie)	C (soiuri cu stria□ii, u□or colorate)	D (alte soiuri)
	Suprafa□a totală a colora□iei ro□ii specifice soiului	Suprafa□a totală a colora□iei mixte-ro□ii specifice soiului	Suprafa□a totală a decolorării u□or ro□ii, înro□ite sau cu stria□ii, specifice soiului	
Categoria extra	3/4	1/2	1/3	Nici o cerin□ă în ceea ce prive□te colora□ia ro□ie
Categoria I	1/2	1/3	1/10	
Categoria II	1/4	1/10	–	

2. CRITERII DE ÎNRO□IRE

– Grupa R: Soiuri pentru care înro□irea este o caracteristică a epidermei □i nu constituie un defect în cazul în care este în conformitate cu aspectul tipic al soiului.
– Pentru soiurile enumerate în lista următoare, a căror denumire nu este urmată de litera R, înro□irea este admisă în următoarele limite:

	Categoria „Extra”	Categoria I	Categoria II	Toleran□a pentru categoria II
(i) Pete brune	– care nu depă□esc cavitatea pedunculară	– care pot depă□i u□or cavitatea pedunculului sau a pistilului	– care pot depă□i cavitatea pedunculului sau a pistilului	– fructe care nu pot afecta în mod grav aspectul □i starea coletului
	– care nu sunt rugoase	– care nu sunt rugoase	– u□or rugoase	
(ii) Înro□ire		Maximum admis din suprafa□a fructului		
– reticulară fină (care nu contrastează puternic cu colora□ia generală a fructului)	– urme u□oare □i izolate de înro□ire care nu afectează aspectul general al fructului sau al coletului	1/5	1/2	– fructe care nu pot afecta în mod grav aspectul □i starea coletului
– puternică	– fără	1/20	1/3	– fructe care nu pot afecta în mod grav aspectul □i starea coletului
– cumul de defecte (cu excep□ia petelor brune admise în condi□iile anterioare). În orice caz, înro□irea fină □i cea puternică nu pot depă□i împreună un maximum de:	–	1/5	1/2	– fructe care nu pot afecta în mod grav aspectul □i starea ansamblului coletului

3. CRITERII DE MĂRIME

Grupa FM: Soiuri de mere cu fructe mari prevăzute la al doilea paragraf de la titlul III din standardul pentru mere.

4. LISTA NEEXHAUSTIVĂ A SOIURILOR DE MERE CLASIFICATE DUPĂ CRITERIILE DE COLORA□IE, ÎNRO□IRE □I MĂRIME

Fructele din soiurile care nu fac parte din listă trebuie clasificate în func□ie de caracteristicile soiurilor respective.

Unele dintre soiurile enumerate în următoarea listă pot fi comercializate sub denumirile comerciale pentru care s-a solicitat sau s-a ob□inut protec□ia în una sau mai multe □ări. Prima □i a doua coloană din următorul tabel nu sunt destinate să includă astfel de denumiri de marcă comercială. Anumite mărci cunoscute sunt men□ionate în a treia coloană numai cu titlu informativ.

Soiul	Sinonime	Marca comercială	Grupa de colora□ie	Înro□ire	Mărime
African Red		African Carmine™	B		
Akane	Tohoku 3	Primerouge®	B		
Alborz Seedling			C		
Aldas			B		FM
Alice			B		
Alkmene	Early Windsor		C		
Alwa			B		
Angold			C		FM
Apollo	Beauty of Blackmoor		C		FM
Arkcharm	Arkansas No 18 A 18		C		FM
Arlet			B	R	
Aroma Soiuri mutante de colora□ie ro□ie ale soiului Aroma, de exemplu Aroma Amorosa			C B		
Auksis			B		
Belfort	Pella		B		
Belle de Boskoop □i soiurile mutante			D	R	FM
Belle fleur double			D		FM
Berlepsch	Freiherr von Berlepsch		C		
Berlepsch rouge	Red Berlepsch Roter Berlepsch		B		
Blushed Golden					FM
Bohemia			B		FM
Boskoop rouge	Red Boskoop Roter Boskoop		B	R	FM
Braeburn Soiuri mutante de colora□ie ro□ie ale soiului Braeburn, de exemplu: Hidala Joburn Lochbuie Red Braeburn Mahana Red Mariri Red Redfield Royal Braeburn		 Hilwell® Aurora™ Red Braeburn™ Southern Rose™ Redfield® Eve™ Red Braeburn™ Southern Rose™ Red Braeburn™ Southern Rose™	B A		FM FM
Bramley's Seedling	Bramley Triomphe de Kiel		D		FM
Brettacher Sämling			D		FM
Calville (grupul …)			D		FM
Cardinal			B		
Carola	Kalco		C		FM
Caudle		Cameo™	B		
Charden			D		FM
Charles Ross			D		FM
Civni		Rubens®	B		
Coromandel Red	Corodel		A		
Cortland			B		FM
Cox's orange pippin □i soiurile mutante Soiuri mutante de colora□ie ro□ie ale soiului Cox's Orange Pippin de exemplu: Cherry Cox	Cox Orange		C B	R R	
Crimson Bramley					FM
Cripps Pink		Pink Lady®	C		
Cripps Red		Sundowner™	C [1]		
Dalili		Ambassy®	C		FM
Dalinbel			B		
Delblush		Tentation®	D		FM
Delcorf □i soiurile mutante, de exemplu: Dalili Monidel		Delbarestivale® Ambassy®	C		FM
Delgollune		Delbard Jubilé®	B		FM

Soiul	Sinonime	Marca comercială	Grupa de colora□ie	Înro□ire	Mărime
Delicious ordinaire	Ordinary Delicious		B		
Deljeni		Primgold®	D		FM
Delikates			B		
Delor			C		FM
Discovery			C		
Dunn's Seedling			D	R	
Dykmanns Zoet			C		
Egremont Russet			D	R	
Elan			D		FM
Elise	Red Delight	Roblos®	A		FM
Ellison's orange	Ellison		C		FM
Elstar □i soiurile mutante, de exemplu: Daliter Elshof Elstar Armhold Elstar Reinhardt Soiuri mutante de colora□ie ro□ie ale soiului Elstar, de exemplu: Bel-El Daliest Goedhof Red Elstar Valstar		 Elton™ Red Elswout™ Elista™ Elnica™	C B		
Empire			A		
Falstaff			C		
Fiesta	Red Pippin		C		
Florina		Querina®	B		FM
Fortune			D	R	
Fuji □i soiurile mutante			B		FM
Gala Soiuri mutante de colora□ie ro□ie ale soiului Gala, de exemplu: Annaglo Baigent Galaxy Mitchgala Obrogala Regala Regal Prince Tenroy		 Brookfield® Mondial Gala® Gala Must® Royal Gala®	C A		
Garcia			D		FM
Ginger Gold			D		FM
Gloster			B		FM
Goldbohemia			D		FM
Golden Delicious □i soiurile mutante			D		FM
Golden Russet			D	R	
Golden Supreme	Gradigold Golden Extreme		D		FM
Goldrush	Coop 38		D		FM
Goldstar			D		FM
Granny Smith			D		FM
Gravenstein rouge	Red Gravenstein Roter Gravensteiner		B		FM
Gravensteiner	Gravenstein		D		FM
Greensleeves			D		FM
Holsteiner Cox □i soiurile mutante	Holstein		D	R	
Holstein rouge	Red Holstein Roter Holsteiner Cox		C	R	
Honeycrisp		Honeycrunch®	C		FM
Honeygold			D		FM
Horneburger			D		FM
Howgate Wonder	Manga		D		FM
Idared			B		FM
Ingrid Marie			B	R	
Isbranica	Izbranica		C		
Jacob Fisher			D		FM
Jacques Lebel			D		FM

Soiul	Sinonime	Marca comercială	Grupa de colora□ie	Înro□ire	Mărime
Jamba			C		FM
James Grieve □i soiurile mutante	Red James Grieve		D		FM
James Grieve rouge			B		FM
Jarka			C		FM
Jerseymac			B		
Jester			D		FM
Jonagold [(2)] □i soiurile mutante, de exemplu: Crowngold Daligo Daliguy Dalijean Jonagold 2000 Jonabel Jonabres King Jonagold New Jonagold Novajo Schneica Wilmuta	 Jonasty Jonamel Excel Fukushima Veulemanns Jonica		C		FM
Jonagored □i soiurile mutante, de exemplu: Decosta Jomured Jonagold Boerekamp Jomar Jonagored Supra Jonaveld Primo Romagold Rubinstar Red Jonaprince	 Van de Poel Surkijn	 Early Queen® Marnica® First Red® Wilton's® Red Prince®	A		FM
Jonalord			C		
Jonathan			B		
Julia			B		
Jupiter			D		FM
Karmijn de Sonnaville			C	R	FM
Katy	Katja		B		
Kent			D	R	
Kidd's orange red			C	R	
Kim			B		
Koit			C		FM
Krameri Tuvioun			B		
Kukikovskoje			B		
Lady Williams			B		FM
Lane's Prince Albert			D		FM
Laxton's Superb	Laxtons Superb		C	R	
Ligol			B		FM
Lobo			B		
Lodel			A		
Lord Lambourne			C		
Maigold			B		
Mc Intosh			B		
Meelis			B		FM
Melba			B		
Melodie			B		FM
Melrose			C		FM
Meridian			C		
Moonglo			C		
Morgenduft	Imperatore		B		FM
Mutsu		Crispin®	D		FM
Normanda			C		FM
Nueva Europa			C		
Nueva Orleans			B		FM
Odin			B		
Ontario			B		FM
Orlovskoje Polosatoje			C		
Ozark Gold			D		FM
Paula Red			B		
Pero de Cirio			D		FM

Soiul	Sinonime	Marca comercială	Grupa de colora□ie	Înro□ire	Mărime
Piglos			B		FM
Pikant			B		FM
Pikkolo			C		
Pilot			C		
Pimona			C		
Pinova		Corail®	C		
Pirella		Pirol®	B		FM
Piros			C		FM
Rafzubex		Rubinette® Rosso	A		
Rafzubin		Rubinette®	C		
Rajka			B		
Rambour d'hiver			D		FM
Rambour Franc			B		
Reanda			B		FM
Rebella			C		FM
Red Delicious □i soiurile mutante, de exemplu: Erovan Fortuna Delicious Oregon Otago Red Chief Red King Red Spur Red York Richared Royal Red Shotwell Delicious Stark Delicious Starking Starkrimson Strakspur Topred Well Spur	 Early Red One Oregon Spur Delicious		A		FM
Red Dougherty			A		
Red Rome			A		
Redkroft			A		
Regal			A		
Regina			B		FM
Reglindis			C		FM
Reine des Reinettes	Goldparmäne Gold Parmoné		C		
Reineta Encarnada			B		
Reinette Rouge du Canada			B		FM
Reinette d'Orléans			D		FM
Reinette Blanche du Canada	Reinette du Canada Canada Blanc Kanadarenette		D	R	FM
Reinette de France			D		FM
Reinette de Landsberg			D		FM
Reinette grise du Canada	Graue Kanadarenette		D	R	FM
Relinda			C		
Remo			B		
Renora			B		FM
Resi			B		
Resista			D		FM
Retina			B		FM
Rewena			B		FM
Roja de Benejama	Verruga, Roja del Valle Clavelina		A		
Rome Beauty	Belle de Rome Rome		B		
Rosana	Berner Rosenapfel		B		FM
Royal Beaut			A		FM
Rubin			C		FM
Rubinola			B		FM
Sciearly		Pacific Beauty™	A		

Soiul	Sinonime	Marca comercială	Grupa de colora□ie	Înro□ire	Mărime
Scifresh		Jazz™	B		
Sciglo		Southern Snap™	A		
Sciray	GS48		A		
Scired		Pacific Queen™	A	R	
Sciros		Pacific Rose™	A		FM
Selena			B		FM
Shampion			B		FM
Sidrunkollane Talioun			D		FM
Sinap Orlovskij	Orlovski Sinap		D		FM
Snygold	Earlygold		D		FM
Sommerregent			C		
Spartan			A		
Splendour			A		
St. Edmunds Pippin			D	R	
Stark's Earliest			C		
Štaris	Staris		A		
Sturmer Pippin			D	R	
Sügisdessert			C		FM
Sügisjoonik			C		FM
Summerred			B		
Sunrise			A		
Sunset			D	R	
Suntan			D	R	FM
Sweet Caroline			C		FM
Talvenauding			B		
Tellisaare			B		
Tiina			B		FM
Topaz			B		
Tydeman's Early Worcester	Tydeman's Early		B		FM
Veteran			B		
Vista Bella	Bellavista		B		
Wealthy			B		
Worcester Pearmain			B		
York			B		

(1) Cel puțin 20 % de colorație roşie din categoriile I şi II.
(2) Cu toate acestea, pentru soiul Jonagold, se impune ca fructele clasificate în categoria II să prezinte pe cel puțin 10 % din suprafața lor o colorație roşie cu striații.