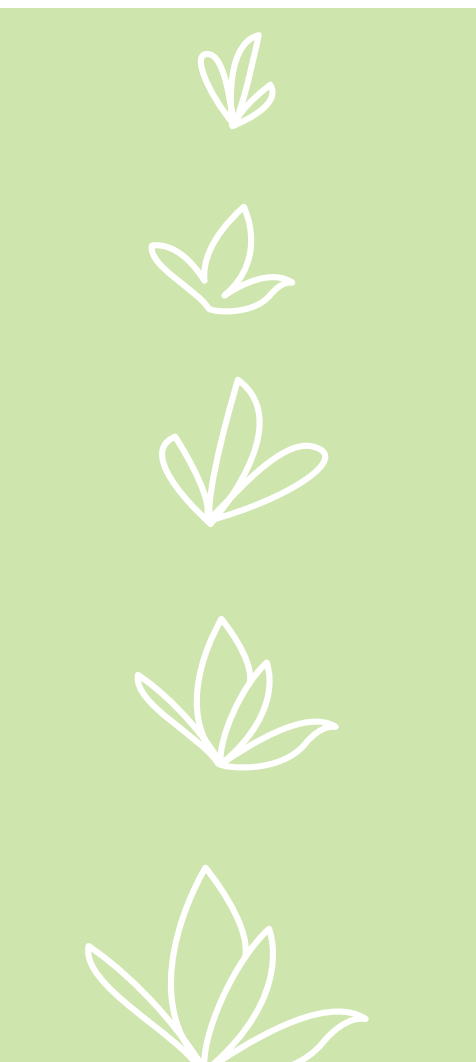


Why do we throw away edible fruit and vegetables?



- We believe that marketing standards have only a limited effect on waste in Sweden. Instead, high quality requirements of retailers and consumers cause most of the waste.
- Many requirements demanded by retailers and consumers are cosmetic and have little or no effect on the eating quality of the products.
- Waste in primary production of fruit and vegetables varies between 0 and 30 per cent depending on the product.

Why do we throw away edible fruit and vegetables?

This study was financed by the National Food Agency as a part of their Government mission to reduce unnecessary food waste in all parts of the food chain. This mission runs from 2013 to 2015 and is to be carried out in cooperation with the Board of Agriculture and the Environmental Protection Agency.

This report describes various causes of waste in the sector of fresh fruit and vegetables, as well as the purpose and function of marketing standards. It then moves on to the core issue: the effect that marketing standards have on waste. Finally, it discusses how to reduce waste and the effect that marketing standards have upon it.

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Division for Trade and Markets

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Photo front page
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Summary

Food waste has received increased attention in the last years. In terms of fresh fruits and vegetables, trade standards are sometimes mentioned as one cause contributing to the waste. Trade standards are standardized product descriptions used by commercial buyers and sellers to facilitate communication about products that are not physically inspected by the buyer before the deal. The aim of this report is to discuss the reasons for waste of fresh fruits and vegetables, to what extent trade standards influence this waste and if possible to suggest measures to decrease the waste. The report covers the chain from production to retail.

Several factors influence the amount of waste. Market requirements, i.e. the requirements on appearance, variety, size, maturity etc. that wholesalers, importers and in the end consumers have, are essential as is the price they are prepared to pay for these products. In connection to harvest, products may be left in the field, or be discarded when sorted, either due to defects making them unsaleable or due to the price being so low that it is not profitable to sell them. If the marketed volume was lower, prices would increase and tolerances for defects would increase. A large marketed volume with low prices is however positive for consumers and for public health.

A central issue in relation to whether trade standards contribute to waste is to what extent trade standards reflect market requirements. If trade standards describe market requirements, these requirements exist irrespective of whether they are put down in trade standards or not. In this case it is mainly the market's requirements that cause the waste. Trade standards that are less strict than the market's requirements also have no impact on waste. If, however, trade standards do not reflect market requirements, but are stricter than these and thus prevent the sale of products, then they most likely increase waste.

We judge that trade standards only have a limited impact on food waste in the sector of fresh fruits and vegetables. This is based on the fact that retail chains that in Sweden answer for 80 per cent of food sold in Sweden have stricter requirements on quality than the lowest quality limit of trade standards. Only to a very limited extent do they buy products of a quality lower than category I. The lowest quality sold by the large retailer chains is therefore the lower limit of category I and not the lower limit of trade standards which is the lower limit of category II.

It would be desirable to get traders, retailers and consumers to attach less importance to exterior qualities that do not influence eating quality. It is however probably not easy to achieve.

There are however a great number of practical measures that can be taken to decrease waste. Many of them are used already today but there is probably room for improvements; adjusting production to demanded quality, harvesting more than once, alternative outlets, correct cooling and management after harvest and avoiding marketing "piles" of products in the stores.

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1 Introduction

In recent years food waste has drawn increased attention for many reasons. One reason is that by reducing food waste we increase our chances of feeding the growing global population. Another reason has to do with sustainability, since wasting food means wasting resources that effect both the climate and our environment.

It is difficult to estimate waste in fruit and vegetables, i.a. since that sector contains many products with very different characteristics and keeping qualities. Furthermore, the same product – like apples – can come from either a local producer or from the other side of the planet, and the date of harvest affects both its keeping qualities and its characteristics, but its keeping qualities are also affected by the temperature during harvest as well as by a host of factors both before and after harvest. This means that waste can vary a lot both from product to product but also from batch to batch of the same product.

In Sweden, waste during production has been estimated to 0-30 per cent depending on the product. Waste also occurs due to quality loss during transport and handling, and during storage at wholesalers and importers, and of course also during sales by retailers. In addition, imported products may be subject to long transports, which increase waste and require careful handling.

Marketing standards are often mentioned as a contributing factor to waste of fresh fruit and vegetables, since legal standards lay down that products that do not meet a certain quality must not be sold for fresh consumption. At present, eleven fresh fruits and vegetables have their own specific marketing standard that must be complied with according to EU legislation. This may not sound like much, but those eleven products make up some 75 per cent of total value of sales of fresh fruit and vegetables within the EU. For other products, a general marketing standard with more basic requirements applies.

Of course, many factors have an effect on waste in the sector. The market has its own requirements, different qualities bring different prices and this in turn leads to financial decisions, and time, temperature and handling have an effect on product quality during distribution. Furthermore, wholesalers and retailers distribute a wide range of products that demand very different handling all over a country that is so long that if you could turn it upside down it would reach all the way to Rome.

1.1 Purpose and limitations

The purpose of this report is to describe the factors that influence waste of fresh fruit and vegetables, the importance of marketing standards, and – if possible – to suggest measures that could reduce waste.

The report discusses waste at all stages of the distribution and marketing chain starting with production and continuing on to storage (if any), sorting, transport, and handling at wholesalers and retailers. On the other hand, it does not include waste at the consumer stage. Also, our discussion does not include waste that is caused by weight loss due to the fact that products lose moisture during storage, provided that such storage does not result in the products being discarded or used as feed.

We use the term waste to include products that are grown into a product ready for sale but that are not used as food. This means that products that cannot be sold to the fresh market but that are delivered to the food industry do not count as waste. On the other hand, waste includes products that are left in the field or used as feed. However, for the private entrepreneur it may sometimes pay better to sell defect products as feed rather than to the food industry.

This report refers to the situation in Sweden. However, we have also discussed the issue with experts from the UK, Germany, the US and France.

Finally, we would like to point out that this study only refers to marketing standards laid down by the EU, the UNECE and Codex. Private standards laid down by private companies are not addressed in this report, except to explain how such standards are different from the marketing standards.

1.2 Definitions

We use the same definitions as in the report we produced for the Nordic Council of Ministers in 2013: Food Waste in Primary Production.¹

Consequently, food waste in this study means:

”Food that was produced in order to be eaten by people, but that is not eaten, for one reason or another.”

Food in this study refers to:

”Any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans.”
(Definition of food according to EC 178/2002.)

According to Regulation EC 178/2002 plants before harvest are not included in the definition of food, unless they have been treated in order to be released onto the market as food. This means that food waste includes plants and parts of plants after harvest.

Primary production includes both food waste and production losses. The concept of production losses includes for instance losses due to plant pests. This study comprises both food waste and production losses in order to get a complete picture of primary production. Like we did in the report to the Nordic Council of Ministers, we use the word waste to refer to both factors.

¹ Franke et al, 2013.

2 Waste of fresh fruits and vegetables

Fruit and vegetable waste can vary considerably from one product to another. This is because fruit and vegetables make up a very heterogeneous sector that contains both rather tough products that can take some ungentle treatment and non-optimal temperatures, and products that are very sensitive both to incorrect handling and incorrect temperature. The first group of products includes most root vegetables, and the sensitive group includes for instance broccoli, asparagus and bananas.

2.1 Waste during growing and harvest varies a lot

It is very difficult to estimate waste during cultivation and harvest, not least because it depends very much on what product is being harvested and the conditions during harvest. A couple of growers estimate waste of field vegetables during harvest to 5-10 per cent², whereas for iceberg lettuce a study indicated that waste was over 20 per cent.³ However, sometimes rot can affect an entire field of iceberg lettuce, and at other times one can harvest almost every head of lettuce.⁴ This makes it hard to provide a general figure. The figure of 20 per cent does not include biomass that is normally left in the field when harvesting various types of lettuce or cauliflower, even though some of that biomass could have been eaten.

Products can be discarded either in the field or during later sorting and packaging. Cauliflower, iceberg lettuce and several other types of lettuce grown in open air are sorted in the field; bad products either do not get harvested or are discarded in the field after a quick inspection. The products may have damages or defects, be of the wrong size or be at the wrong developmental stage. They may also have become impossible to sell, for instance curled-leaved endives that have run to seed. When carrots are harvested by machines, you get some waste if the tops break when the carrot is pulled out of the ground, and if carrots fall through when the soil is removed. Carrots may also be damaged during harvest, for instance on the moving belts of the harvest machine. Carrots can be harvested and stored in many ways, but most of them are not sorted until it is time for the products to be packaged and sold. For a large part of the year, that means that they have been stored before that.

The grower sets the lower quality limit for acceptable products depending on what outlets he or she has for the products. The grower may choose to harvest only products that meet the criteria of class I, if their main buyer only wants products of that quality. The grower may decide that the price paid for class II is not enough to cover the cost of harvesting, sorting, packaging and transporting the products to a buyer, or to cover the time required to sell the products at their own farm or to a local vendor.

If prices are more favourable, the grower can choose to harvest class II products as well as products that do not meet the criteria for class II. It is possible to sell products that do not meet the criteria of class II at an on-farm shop, as raw

2 Carrots – Marianne Härning Nilsson – verbal communication, open-air vegetables Per Nordmark, verbal communication.

3 Marie Olsson, 2014.

4 Anette Bordström, verbal communication.

material for the food industry, or for home processing. (Unsorted products or products that do not meet the criteria for class II may be sold at a shop at the farm where they were grown.) Selling products for home processing, however, is not a commonly used option. One important factor is the opportunity to store products until prices improve. However, that requires sufficient cooling capacity.

Maturity or stage of development is another criteria used for a first selection. For financial reasons, the grower may decide to only harvest a field once, and products that are not mature at that time will be left in the field. If you harvest more than once you reduce waste, but it is up to the farmer to judge whether this pays off or not. As regards fruit, one may not sell fruits that are not sufficiently developed to be able to mature into fully ripe fruits. However, only a small share of all fruit is left on the trees, since most growers harvest such fruit as well during the last harvest of the year, in order to sell them for processing.⁵

At present, windfall apples cannot be used on the fresh market, and also cannot be sold for processing, since the mycotoxin patulin may form when the product is attacked by mould. This affects some 5-10 per cent⁶ of the harvest. The fact that windfalls cannot be used even for processing has nothing to do with the marketing standards, but is a requirement based on quality certification.

Products may also be left in the field at times when the market for the current product is satiated.⁷ This may happen after a period with a lot of sunshine that caused products to ripen quicker than normal. The grower may then decide that the product will not yield a price that would justify harvest.

When products are trimmed after harvest or after storage, sometimes one detects pests, rotting and mould to such an extent that the entire product is thrown away. For instance, it is quite common to find cabbage root fly larvae when trimming white cabbage and swedes.⁸ Blossom beetles in cauliflower do not damage the products, but if there are more than just a few of them they make the product impossible to sell. Cleaning and polishing products like carrots also contribute to waste, since all forms of handling cause some damage. If products are sorted and packaged in a packing plant, once again one has to look at the price for different quality segments and decide which products can profitably be sold on the market for fresh produce, which should go to processing, and which not to sell at all.

The reasoning above makes it clear that the decisions taken early on in the production and distribution chain about which products to sell, to a large extent depend on financial considerations. In other words, they are based on what price you get for each quality class. The marketing standards will therefore contribute to waste, but not by directly prohibiting the sale of a product, but rather because the price of some products that do not meet the class I requirements is not high enough to justify selling the products on the market.

5 Lars-Olof Börjesson, verbal communication.

6 Lars-Olof Börjesson, verbal communication.

7 Waarts, Y et al, 2011.

8 Anette Borgström, verbal communication.

However, if supply falls, the requirements can be modified as the price increases. One good example of this happened one year when Swedish apples were struck by frost during bloom, which resulted in a very small supply of apples in class I. The cold weather caused elongated skin defects on the fruit. Such defects have no effect on the eating quality or the nutritional value of the fruit, but is cosmetic only. However, their presence this year meant that a large part of the Swedish apple production did not meet the criteria for class I, but had to be sold as class II. However, this year both retailers and consumers accepted that particular skin defect, and the apples were sold as class II but at prices very close to those of class I.

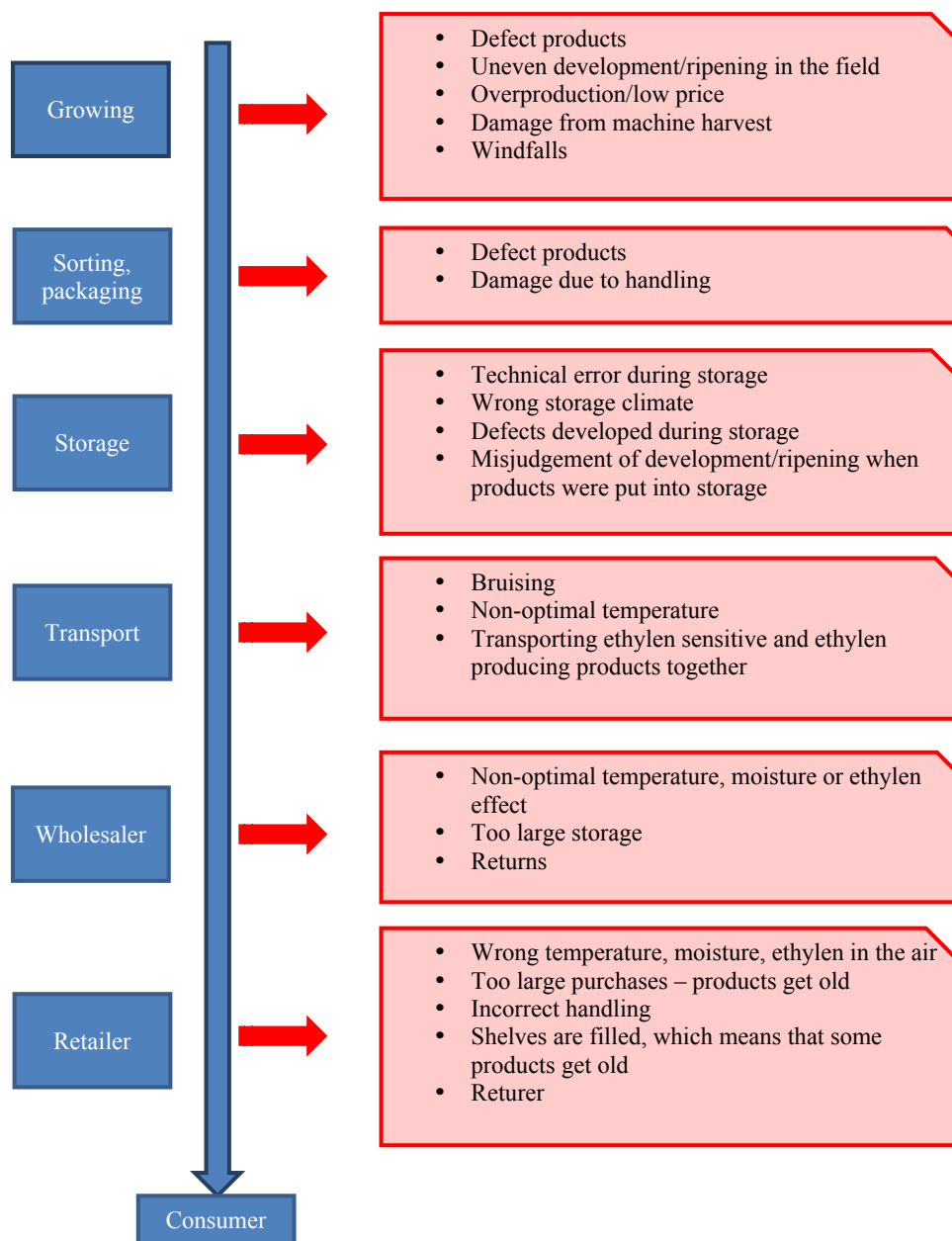


Figure 1. Reasons for food waste in different parts of the production- distribution- and retail chain.

We can learn several things from this episode. One is that the market, i.e. both consumers and retailers, lower their requirements as regards cosmetic quality when supply falls. Another lesson is that consumers do not mind eating apples with elongated skin defects, and that it might be possible to remove this requirement from class I. In the year in question, the producer organisation Äppelriket ran a campaign that explained why the apples looked the way they did. The campaign, and the fact that the defect was both widespread and temporary, might have contributed to consumer acceptance.

2.2 Much waste occurs during storage

Waste during storage of fruit and vegetables varies a lot, from a few per cent for, for instance, very gently treated white cabbage to 25-30 per cent for carrots. If products are stored, technical errors can cause some of the stored products to be lost. Waste can also be a result of misjudgement of the products' ripeness when they are put into storage, or of not detecting defects that have an effect on their keeping quality. In addition, defects can arise due to storage fungi, and to factors related to the growing of the products, like lack of nutrients, water or bees, or poor weather.

Waste during storage varies due to several factors: weather during the growing season, handling during harvest and putting into storage, if the products were harvested mechanically or by hand, and the degree of infestation of fungi, bacteria and insects. In addition, it of course matters for how long the products are stored. White cabbage is one example. Waste after storage is estimated to some 10-15 per cent.⁹ If the cabbage heads are "treated like eggs" and are healthy when they are put into storage, there is little waste. For swedes as well, waste is about 10-15 per cent. In this case the larvae of the cabbage root fly is the main problem. For carrots, it is various storage diseases. Some 25-30 per cent of the carrots have to be discarded after storage during the main season.¹⁰ In late spring, the share may be 50-60 per cent.

2.3 Temperature during transport is often a compromise

All transports increase the risk of bruising. Such damage can of itself mean that the products cannot be sold, but they also have an indirect effect on quality since the keeping quality of the product is reduced when it is damaged.

When products are transported it is also difficult to maintain a temperature that is optimal for all kinds of products. Products have different needs as regards temperature, and it is usually not possible to keep products separate during transport in order to give each type the right temperature. This is why it is common for fruit and vegetables to be transported at a temperature of about 8-19 degrees Celsius, which is considered an acceptable compromise.

⁹ Anette Borgström, verbal communication.

¹⁰ Marianne Härning-Nilsson, Anette Borgström, verbal communication.

2.4 Wholesalers check the quality of the products

When wholesalers receive the products they check their quality. A quality inspector checks to see that the products are of the quality agreed in the contract. The contract lays down what quality class, size and colour (if relevant) that the buyer has ordered and agreed to pay for. Upon arrival, the buyer may notice that the products are not of the agreed quality. It is of course possible that the sender packed faulty products, but the error may also have arisen during transport and handling. The longer the transport, the greater the risk that quality deteriorates.

One option when receiving non-conformity products is to sort and pack the products again. Companies may choose to do so for instance if they have received a delivery of citrus fruit in which many boxes contain one or a few fruits infested with green mould. Such a lot would not meet the criteria of class I of the marketing standard, which only allows one per cent of the fruit to be affected by decay. If the decay only comprises a limited share of products, it may be worth the effort to sort the products again. However, this is an expensive procedure and it is not always profitable to do so. Furthermore, if you repack a box in which one or two fruits are mouldy, all products will have mould spores on their peel. This means that it is likely that the lot soon will have mouldy products again, either in the shop or when the products reach the consumers' homes.

A similar situation arises for apples affected by Bitter Pit. This defect is not caused by a fungus or bacterium, but is a physiological defect caused by several factors, the most important of which is low calcium level of the fruit. This gives the apples brown, depressed spots under the peel, which means that they do not meet the minimum requirement of the marketing standard. The symptoms usually arise after some time in storage, and especially afterwards when products are brought out into higher temperatures. If a lot of apples show signs of Bitter Pit, it is likely that the entire lot is low in calcium.

If the non-conformity products come from Swedish growers, they are usually returned to sender. What the sender chooses to do with them then depends both on the type of product and the quality error in question. For instance, apples returned to the main producer organisation Äppelriktet are usually sold for processing, and returned carrots are often sold as feed.

If the wholesaler has ordered too much products, the products may be left in store for so long that they cannot be sold, or that they need to be resorted before sale. According to the wholesalers themselves, this is rare. Storage conditions at the wholesalers' facilities are not always optimal for all products. Some products may be stored at a temperature that is too high, in air that is too dry, or be exposed to ethylene from other products, which may result in damage and increased waste.

Another reason for waste at the wholesaler stage is that loading pallets collapse. This is often caused by the use of so-called B pallets (used and repaired), or of single use pallets that are made from weaker wood. When a pallet collapses, the boxes spill and the products have to be discarded.¹¹

¹¹ Hans Jönsson, verbal communication.

2.5 Poor handling is common at the supermarket

At the retailer stage, the fruit and vegetable segment is the one with the largest degree of waste, both in value and in volume terms. A study by the Swedish University of Agricultural Sciences (SLU) estimates waste of fruit and vegetables to 4.9 per cent of the delivered weight, including returns¹².

When products arrive at the supermarket they, like the wholesaler, check that the products meet the requirements of the quality class ordered. The supermarket may come to a different conclusion about the quality than the supplying wholesaler. It may then decide to return the products to the wholesaler, or the parties can agree that the products are to be discarded. Products are usually not re-sorted at the retail stage.

At the retail stage, waste may be caused by incorrect handling or storage, or by placing too large orders. Incorrect handling involves for instance staff turning boxes upside down, which results in bruised products. If such products are sold immediately, the damage is often not visible until the consumer has brought the product home, but if the product is sold later a bruise may develop which will make the product age faster, and it is more likely to be rejected by consumers.

Incorrect storage at the retail stage is usually about products being kept at the wrong temperature. This may mean that products that should be kept cool are kept at room temperature, but the reverse also happens: products are kept cool even though they cannot take the cold. Ethylene levels (a gas emitted by fruits and that causes fruits and vegetables to age faster) are rarely high in the supermarket itself, but may be high in their storage areas, and that increases waste.

Another reason for waste may be that the retailer ordered more products than they can sell before they start to lose their freshness. This may of course be due to a misjudgement, but it may also happen because the retailer gets a discount for ordering larger volumes, or because they have to reach a minimum order volume¹³. Also, retailers do not want empty shelves, so they fill them up during the day. Consumers usually choose the freshest products, so the products that have been on the shelf the longest will eventually have to be removed. In such a case, the buyers have the product right in front of them and can decide for themselves if the product is worth the price that the the supermarket is asking for. In that situation, the marketing standards have no or very little effect on waste. Furthermore, the SLU study¹⁴ found that the volumes returned to the supplier were larger than waste at the retail stage. Returns from the retailer back to the wholesaler do not necessarily cause waste, since the products can be delivered to another buyer if their quality is sufficient.

12 Eriksson, M., Strid, I. 2013 (a).

13 Eriksson, M., Strid, I. 2013 (b).

14 Eriksson, M., Strid, I. 2013 (a).

3 Marketing standards: what are they, why do they exist and how are they made?

3.1 What is a marketing standard?

Marketing standards are a defined collection of parameters used for describing products and a system for classification based on quantifiable characteristics¹⁵. This somewhat cryptic phrase means that a marketing standard is a product description with a clearly defined content, usually based on a standardized model.

The marketing standard may contain a classification establishing different levels of requirements. This makes it possible to set different prices for different levels (classes), and in this way you can get a higher price for products of good quality. This means that such marketing standards contribute to creating quality premiums in production, and to increasing profitability¹⁶. The EU Common Market Organisation (Regulation 1308/2013, Articles 75 and 76) lays down rules on marketing standards for fruit and vegetables, olive oil and table olives, bananas, live plants, eggs, and poultry meat.

In other words, marketing standards are tools intended to facilitate trade by providing standardized product descriptions that clarify and standardize the buyer's requirements to the seller. Their aim is not to limit risks to human and animal health nor to limit the spread of plant pests. However, certain marketing standards, like the ones for eggs and poultry, do require products to be clean and that the animals have been kept and handled in accordance with animal welfare rules. This is a case of clarifying what the market requires of the products. However, the requirements are also laid down in animal welfare and food legislation, so their presence in the marketing standards is not primarily in order to ensure food safety or animal welfare.

Marketing standards are based on agreements between many parties who often represent different countries. This means that the very work of drawing up marketing standards contributes to harmonizing product descriptions that form the basis for business transactions between buyers and sellers.

Another type of standards is the private standards drawn up by companies, often retail chains, in order to distinguish their products from those of their competitors. Such private standards are the buyer's specification of requirements to the supplier. Unlike marketing standards, which are harmonized requirements to be used by many companies, private standards are drawn up by a single company. This means that the aim of private standards is the opposite of the aim of a marketing standard, even though both are used to communicate buyer requirements.

¹⁵ Jones and Hill, 1994.

¹⁶ Moisé et al 2013.

To complicate matters further, there are also process standards that describe processes. They often describe processes of control or production in order to guarantee that companies produce and handle their products safely. Examples of process standards include HACCP, ISO standards and BRC.

3.2 Why are marketing standards used?

Standards are used in many areas. They are common in agricultural production since living products naturally vary, and the marketing standards are a tool to deal with this variation¹⁷.

Marketing standards are relevant for commercial operations. It is a common misconception that marketing standards are there to protect consumers from inferior products: that is not their main purpose. Rather, their main purpose is to facilitate professional trade. Marketing standards are there to facilitate communication between buyer and seller, increase market transparency, and to improve quality of the products traded in order to increase profitability of the sector. This is particularly true for products with a natural variation that cannot be eliminated during production, and agricultural products fit that description very well.

In practice, standards influence trade by providing clear descriptions that facilitate communication between buyers and sellers. It is enough for the buyer to state “class I” in order to tell the supplier that all class I requirements for the relevant product are to be met. When the products are delivered to the wholesaler the recipient company checks a sample of products to ensure that they have the received the quality that they ordered and that the price is based on. If the products do not meet the requirements specified in the standard the products can be returned to the sender or the price can be adjusted.

However, marketing standards can have the opposite effect and work as a barrier to trade, since a cost is associated with meeting the requirements, and with showing that you have met them¹⁸. This is more likely to be a problem if there are more than one marketing standard for the same product. This is why countries should adopt international marketing standards rather than develop their own¹⁹. However, if the marketing standards are to be used both domestically and for export, they need to be adapted to both kinds of market²⁰.

Even though the main purpose of the standards not is to protect consumers from inferior products, products of poor quality are still eliminated by the requirements of the standards. The marketing standards of the UNECE and of the EU for fresh fruit and vegetables have no section on food safety, but the minimum requirements do state that the products have to be “sound; produce affected by rotting or deterioration such as to make it unfit for consumption is excluded”, and the point of that phrase is to ensure that the products are safe. Codex norms include a section that lays down thresholds for pesticide residues and other foreign

17 ADAS, 2003.

18 Ferro et al, 2013.

19 Stephenson, S.M. 1997.

20 Moisé et al 2013.

substances, as well as general rules of hygiene to be complied with. The requirement that products be sound also counteracts the spread of contagious plant diseases. This protection can be reinforced by adding extra strict requirements regarding a certain disease.

If marketing standards work the way they should, they facilitate trade by clarifying the buyer's requirements to those who grow, sort and pack the produce. If there are no marketing standards, buyers and sellers have to specify what they have agreed on as regards quality, size, and other aspects. This would take time and increase costs. It would also increase the risk of error. In other words, both transaction cost and risk would increase²¹. This is true not least for developing countries, since the standards communicate the requirements in place to growers and packing facilities who operate far from the markets that they want to sell their products to²².

If there are no marketing standards, the way is open for private standards since they partially refer to the same criteria. However, while the point of marketing standards is to harmonize requirements in order to facilitate trade, the point of private standards is the opposite; to distinguish their products from competing products. This increases cost for suppliers.

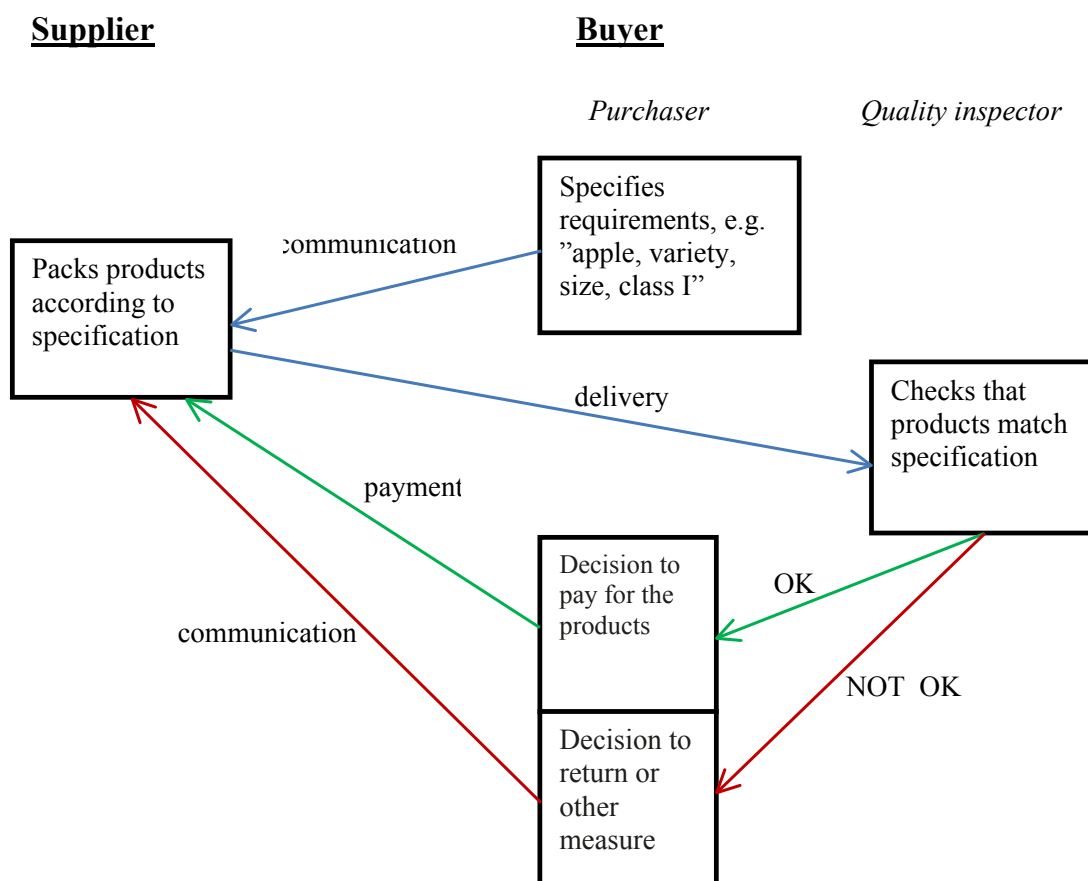


Figure 2. Communication between buyer and seller during trade in fresh fruit and vegetables.

²¹ Reardon et al 2001; ADAS, 2003.

²² Jaffee and Henderson, 2004.

3.3 What are the marketing standards for fresh fruit and vegetables?

Several countries, like the US and Russia, have national standards for fresh fruit and vegetables. We do not comment on those here, but limit ourselves to the international standards laid down by the UN Economic Committee for Europe (UNECE) and Codex.

The UNECE was the first organisation to start developing marketing standards for fresh fruit and vegetables. They began that work in the late 1940s, as one of many tools to rebuild the European economy and to reinforce the peace. Their first two international standards, for apples/pears and for potatoes, were published in 1952.²³ Since then the organisation has adopted 51 marketing standards for fresh fruit and vegetables, most of which grow in temperate climates. The UNECE also produces marketing standards for dry and dried fruit and vegetables, as well as for meats and seed potatoes.

Codex Alimentarius, another UN organ under the FAO that began in 1963, lays down norms and standards for many products. As regards fresh fruit and vegetables, at first they only developed standards for tropical products. In the late 1990s it was decided that they should also develop standards for fruits from a temperate climate. Codex has adopted marketing standards for 32 fresh fruits and vegetables (please see Annex 3).

A common feature of the UNECE and the Codex marketing standards is that they are developed internationally as a tool for countries to use. It is then up to each country to decide how to apply the standards (if they are to be voluntary or compulsory). If their application is made compulsory, the marketing standards need to be introduced into national legislation in some form. The standards can also be used by individual companies as a basis for commercial agreements.

The European Community adopted its first marketing standards very shortly after the introduction of the Common Agricultural Policy. The EU is really a region, and its marketing standards could therefore be seen as comparable to those of the US or Russia. However, the EU is now a union of 28 countries, one of which is Sweden, so we discuss their standards here.

The EU currently has 11 product-specific marketing standards that are almost identical to those of the UNECE. However, there are some differences. The EU standards are mostly developed within the UNECE, and the EU has subsequently adopted these standards for application within the EU.

This means that the marketing standard for cucumber²⁴, the origin of which has been attributed to EU bureaucrats, was not developed in the EU but by the UNECE. Representatives of the Netherlands, Italy, Belgium, Poland, Spain, the UK and Germany agreed on it in March 1964, including the requirement that if the cucumbers are quite crooked this should be clear from the label. There has never been any prohibition against selling crooked cucumbers.

²³ United Nations, 1988.

²⁴ UNECE, 1964.

Eleven marketing standards may not seem like much, but they concern the most traded products on the market, and together they represent 75 per cent of the value of all fruit and vegetables on the EU market²⁵. All other fruit and vegetables are comprised by a general marketing standard whose content corresponds to the basic minimum requirements of the product-specific standards. It also has the same requirements about marking with sender and country of origin on the label. Companies may choose to use the UNECE product-specific standard instead of the general marketing standard.

The EU has decided that marketing standards are compulsory, and it is up to Member States to ensure compliance. This report focuses on product-specific standards. The reason is that most trade in fresh fruit and vegetables in Sweden is based on product-specific standards. The companies use the UNECE standards for products that the EU does not have product-specific standards for.

The Organisation for Economic Cooperation and Development (OECD) started their work with marketing standards for fresh fruit and vegetables in the early 1960s, in order to facilitate trade between its members. However, in 1962 the organisation stopped developing new standards, in order to avoid duplicating the work of the UNECE. Instead, the OECD focuses on interpretation of the UNECE standards. They do this by producing pictures that show what the requirements of the standards mean in practice.

3.4 How are marketing standards created?

Marketing standards are often mentioned as a contributing factor to food waste in the fruit and vegetable sector. However, that explanation does not help much, since marketing standards are just a tool for communicating the requirements agreed by the meeting that adopted or amended the standard. In order to get closer to the real reason for food waste you need to identify who is behind the requirements that end up in the standards.

If marketing standards were created based on a theoretical reasoning about how the products ought to look, marketing standards would control the market. On the other hand, if standards are a way to communicate market requirements, the real cause of waste is not the standards themselves but rather the market requirements. The UNECE work on standards (which are used in Sweden) bases its discussions on opinions from producers and traders in member countries. However, since many countries take part in the discussions, the result is a compromise between the wishes of producers and traders in all countries that have a stake in the product in question.

At the UNECE, which is the organisation that has been developing the most standards for fresh fruit and vegetables, participating countries meet for one week every year to discuss the development of new standards and revisions of the existing ones. The proposals discussed come from the participating countries. The proposals, as well as the opinions expressed at the meetings, usually come from producers or wholesalers/retailers, and are supposed to have the support of other actors than the ones putting the proposal forward. However, in some countries the producers have the largest influence, and in others it is the wholesalers/retailers.

²⁵ EU Commission, 2009.

Codex standards are developed in a similar manner:

- a) one or more actors (producers/ wholesalers/retailers/consumer organisation) suggests a new standard or an amendment to an existing one.
- b) The national authority sends the initiative for comments to other actors in the country.

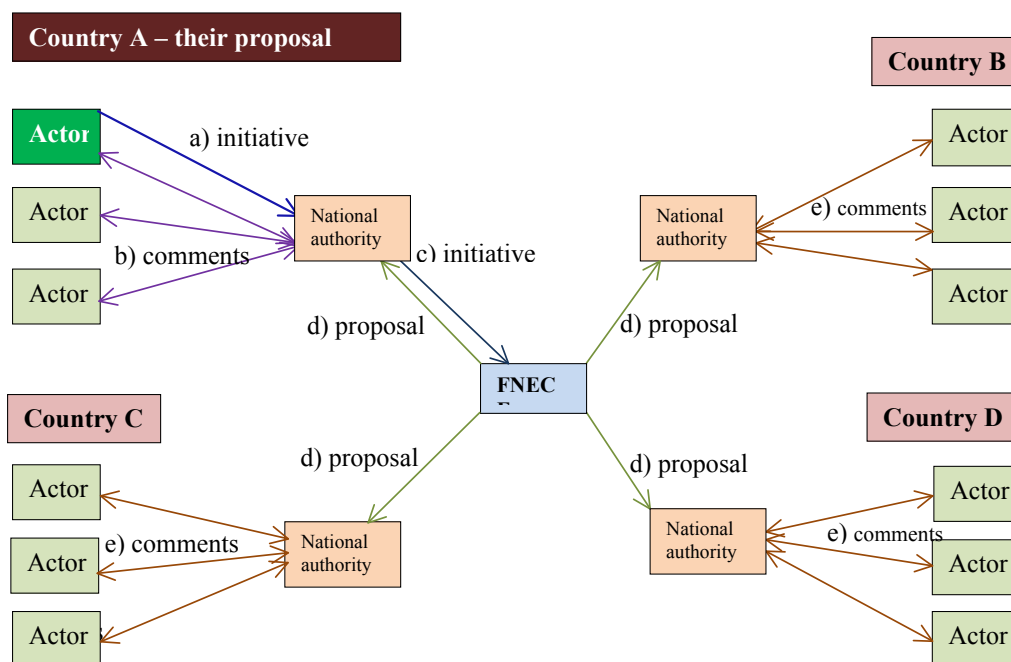


Figure 3. How a proposal is prepared for a UNECE meeting. c) If the initiative is approved the country submits it to the UNECE. d) The UNECE draws up a proposal and submits it to all countries. e) Each country sends the proposal for comments to all actors concerned. The proposal is then discussed at the next UNECE meeting.

The eleven EU standards that are compulsory within the Union are almost identical with the UNECE standards. This means that Member States who want to change the EU standards have to work through the UNECE. There, Member States act nationally even though the EU holds meetings to prepare the UNECE agenda.

The OECD interprets the standards by producing interpretative materials with pictures that describe what the various requirements mean. This interpretation is probably as important to trade as the standards themselves. In the interpretative work, participating countries agree on what is meant by the phrasing in the standards. This is made clear by the pictures, and the documents are published (see figure 4). For many defects the material shows where to draw the line between acceptable and unacceptable, and this serves as a guideline both for those who pack the products and those who receive them.

The work on each product is led by a coordinator who is to involve both the sector and the countries most concerned. The interpretative work on a given standard is often led by one country that has a large production of the product in question. If this is a product with a large trade value, discussions can become intense. This was for instance the case when the most recent interpretation on citrus fruit was produced, since the major producing countries disagreed on what cosmetic defects to accept.

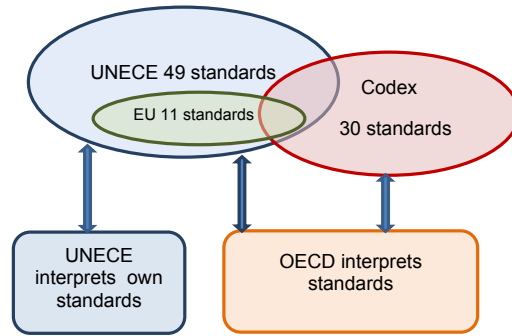


Figure 4. The work on fruit and vegetable standards and their interpretation. The EU has standards for eleven products, almost identical to the corresponding UNECE standards. For five products both the UNECE and the Codex have produced standards, and two of these products are also comprised by EU standards. The OECD interprets standards produced by both the Codex and the UNECE, whereas the UNECE only interprets its own standards.

Sometimes, differences in how countries use the products can give rise to discussions on which criteria are important for trade. Such differences can be significant both for the requirements themselves and for their interpretation. The Swedish habit of eating strawberries with milk is a source of amazement to many countries. If strawberries are eaten in a bowl of milk there is less focus on their appearance. In other countries, strawberries are more commonly used as decoration on pastries, or are sold with long stems in order to be dipped in chocolate and eaten one by one. In those cases appearance is more important, and customers buy class Extra, which is very rare in Sweden.

Consumer aspects are important in this context. In general, direct views from the consumer stage are less represented than views from producers and traders when the standards are drawn up. On the other hand, the consumer aspect is at the heart of almost all discussions, since consumer acceptance is a prerequisite for selling the products.

To sum up, standards are drawn up and amended based on opinions from retailers, wholesalers and producers. This means that the requirements would remain also if the standards were removed. This suggests that the market sets the standards and not the reverse. However, it is impossible to get a complete match since markets differ from country to country and the standards are a compromise to be applied in many countries.



Figure 5. Excerpt from OECD interpretative material for strawberries, showing strawberries of class I.²⁶

²⁶ OECD, 2005.

4 Effect on waste

Marketing standards, in this case for fresh fruit and vegetables, can both increase and decrease waste. However, we believe that their effect is limited since the market requirements are stricter than the lower quality limit of the marketing standards.

4.1 How can marketing standards increase waste?

Marketing standards increase waste when they prevent the sale of a product that the market demands. A condition is that the products actually are produced and demanded to a significant extent. However, waste can arise even if the standards do not completely forbid the sale of a product. A voluntary but widespread use of standards can have the same effect.

Marketing standards can also have an indirect effect on waste by influencing the price of products. Financial considerations can lead to products of a lower quality class not being harvested or being discarded, even if they could have been sold.

4.1.1 The lower quality limit for what may be sold

In theory, the most important limit is the lower limit of class II, since this is what decides if the products may be sold fresh to consumers or not, and this is the limit that has the largest effect on price. This means that the limit is significant for waste, since financial considerations determine whether products are harvested or not, and this depends on what price you can get for them.

The limits between class Extra and class I, and between class I and II, are more explicitly commercial limits that will have an effect on price. However, this is partly a theoretical argument since the large actors buy class II products only to a limited extent. Therefore, the actual acceptance threshold is usually the lower limit of class I. However, producers can still sell class II products to some other market, often a local market, or sell the products for industrial or home processing.

However, products that do not meet the requirements of class II do not need to be thrown away. As long as they are not decaying or have other defects that make them unfit for consumption, they can be used for other things. Asparagus can go to the canning industry, carrots can be carved into special shapes, apples can go to cider or juice production, strawberries can become jam, and so on. In other words, the lower limit of class II only prevents products from being sold in order to be eaten fresh by the consumer, but they can still be sold for processing. In addition, supermarkets may sell products that do not meet the marketing standards, provided that they are clearly identified as products intended for home processing (Commission Regulation (EU) 543/2011, Article 3 (3)).

When there is a market for products that do not meet the requirements of class II, the lower limit of class II becomes a commercial limit, since products for the processing industry sell for much less than products for the fresh market. For instance, apples of class II may earn SEK 5-6 per kilo on the fresh market, but only SEK 2.5 per kilo if sold to processing. The lowest acceptable quality is then defined by the requirements of the processing industry. They include the absence of decay, but also the correct degree of ripeness in case of products that ripen.

Table 1. Requirements for each quality class and possible uses

	Class Extra	Class I	Class II	Unacceptable
Description	Very fine	Fine	Good eating quality but lower requirements regarding external quality	Products of non-standard shape or other defects that clearly change their characteristics and/or keeping qualities, and products affected by decay, mould, pests, or that are very dirty.
Use	Fresh consumption	Fresh consumption	Fresh consumption, but sometimes other uses	May not be sold for fresh consumption. Products with defects that do not make them unsuitable for consumption may be sold at the grower's own farm, at a supermarket for home processing, to the processing industry, as food, or given to charity.

4.1.2 Requirements of the market or of the standards?

A marketing standard that reflects market requirements or is less strict than the market will have no effect on waste, even if it has a clear lower limit for what products may be sold. The reason is that if marketing standards are identical with, or less strict than, market requirements then the lower limit will have the same effect irrespective of whether or not it is written down in a marketing standard. The basic idea of marketing standards is that they are to communicate and clarify market requirements to producers and packing facilities in order to facilitate trade. This means that a marketing standard that has stricter requirements is a problem. Marketing standards increase waste when they prevent the selling of a product that the market demands and that is being produced. In such a case the marketing standard does not live up to its own basic function to facilitate trade.

The above reasoning is partially theoretical since the market is not homogenous. There are many different market segments that all have their own requirements and tolerances, so a product that cannot be sold on one market can often find buyers somewhere else. In Sweden, the word “market” easily leads people to think about the supermarkets of the main retail chains, since they are so dominant. However, there are many outlets besides the main chains. Some of them also sell products that the retail chains have sold to them, after having decided that they are not good enough for their own supermarkets.

As mentioned already, the lower limit of class I is often the lower limit for what quality the market will accept. The reason is that a very large share of fresh fruit and vegetables sold in the supermarkets of the main retail chains are of class I. This means that there is not much demand for products of class II. It also means that even though the marketing standards allow products to be at the lower limit of class II, the commercial lower threshold is often the lower limit of class I. The retailers rarely want products of class II, and if they buy them they do so at a price that is so low that it is barely profitable for the producers to sell the products. However, one should realise that this is only true when there are enough products on the market for the buyers to have a choice.

4.2 How can marketing standards be used to reduce waste?

As we underlined before, marketing standards make it clear to those who harvest and pack the products what the market expects of them. Waste can be reduced for at least two reasons:

- a. Since buyer requirements are clearly communicated, producers take them into account in their production and make sure to produce and harvest products that are in demand.
- b. The company that packs the products is aware of what the buyer wants and packs products that meet those requirements.

Point (a) is about the producers knowing what the market requires and, to the extent possible, adapts their production to take market demand in account. This means a decline in the share of products that do not fulfil the marketing standards. To a large extent, such adaptation would consist of measures that are carried out anyway in normal production, so they are not associated with adaptation of production to market requirements. For instance, the market does not want large quantities of small apples since they are hard to sell. Because of that, growers remove some fruit when the apples are still young, and this gives the remaining apples a better size. Consumers also want apples with a nice red colour. This leads growers to prune the trees in order to let in more sunlight, and they may also add an extra pruning in the summer to improve fruit colour.

Point (b) is not directly about reducing waste, but ensuring that waste occurs at an earlier stage of the distribution chain. This means that products that are discarded early have not been transported across long distances, and no resources have been spent on trimming, packing and cooling them. Moving waste to an earlier stage does not reduce waste as such, but it does reduce resource use, which is important both for the climate and the environment and for the financial result.

4.3 Other factors linked to marketing standards that affect food waste

4.3.1 Are consumer requirements always relevant?

One factor linked to quality and marketing standards is what consumers expect their product to look like, and if those requirements are always relevant. This leads us directly to the question of what constitutes a relevant requirement. There are several ways to answer that question. If you assume that quality is “characteristics that meet consumer expectations”, then all requirements that consumers may have are relevant. This reasoning takes us no further here.

If you instead assume that characteristics that have an effect on eating quality are the relevant ones, we can sort out some of the requirements. It may be tempting to reject all requirements on external quality as irrelevant, but this would not be correct. Many external characteristics are useful for evaluating internal characteristics that are much harder to verify. This is often a matter of determining how ripe the product is. One example is the link between the colour of the product

and its ripeness. Both growers and consumers know that a completely red strawberry is ripe. Consumers choose red strawberries not because they like the red colour, but because they know that this is linked to ripeness, and hence to eating quality. There are many similar connections that producers, wholesalers and retailers use unconsciously: red colour for tomatoes and yellow colour for bananas are some examples.

However, sometimes consumers come to the wrong conclusions about the link between external characteristics and eating qualities, like the degree of ripeness. The standard for citrus fruit is a good example. The marketing standards says that citrus fruit shall be partially orange. For clementines and satsumas, at least one third of the surface shall be orange, and the equivalent number for oranges is four fifths of the surface. However, the orange colour has no effect on the eating quality of the product, like taste, ripeness or keeping quality. However, consumers, especially in countries that does not grow citrus fruit, have come to associate the orange colour with ripeness. This connection has been reinforced by retailers, who are eager to fully meet consumer expectations and therefore sell citrus fruit that are completely orange or yellow.

The orange colour is primarily developed as a response to low temperatures, but other factors matter as well, like the variety in question and the age of the trees. That means that the first fruits to be harvested during the season, for instance of small citrus, may be rather green since temperatures may still be rather warm even at night. In order to supply the market with fully orange citrus fruit, producers or traders treat the fruit with ethylene (an agent that speeds up the ripening process) for up to a week at a temperature of about 20 degrees. This does not have any effect on the eating quality of the fruit, since sugar levels do not increase after harvest in this kind of fruit. However, the treatment does have a negative effect on the keeping qualities of the fruit. It may also cause damage and increase waste.

Peel damage caused by ethylene treatment in citrus fruit is much more common in the early season. In this case, consumer requirements partially based on ignorance lead to increased waste. At the same time, retailers' eagerness to meet consumer requirements even better than their competitors do, reinforces consumer expectations even though they are based on an incorrect assumption. This means that retailers as well contribute to increased waste. The fact that this requirement has been cemented in the marketing standard for citrus fruit does not help matters.

There is a similar misconception as regards the red colour of apples. Many associate red apples with ripeness, and the lack of red colour in varieties that often are red is taken to mean that the product is not ripe. However, the ripeness of the apple is linked to the green background colour, that changes from dark green to light green or to yellow as the apple ripens. The colour change occurs when chlorophyll is broken down as the product ripens and carotenoids are formed. The red colour does increase during ripening in many apples, but not always. However, the red colour is not linked to degree of ripeness, but is affected by many other factors, including sunlight and low temperatures.

In many cases, the strict requirements of external quality that consumers insist on have been developed by producers, traders and consumers together. When there is a surplus on the market, consumers are quite likely to choose the most attractive

products. Since the retail chains compete with each other, they have an incentive to offer the nicest-looking products in an effort to attract customers. This incentive then travels back through the supply chain, which means that even producer countries can contribute to adding strict cosmetic requirements to the marketing standards; requirements that have nothing to do with eating quality but that do increase waste and also risk increasing the use of pesticides.

Again, the marketing standard for citrus fruit is a useful example. When new interpretation materials were being produced in the mid-00s, discussions got quite intense and focused on the very question of cosmetic quality versus waste, profitability and pesticide use, as well as on consumer acceptance. The marketing standard for class I, which is the relevant class for most citrus fruit on export, accepts the following defects in citrus fruit (among others):

- *slight progressive skin defects, provided they do not affect the flesh,*
- *slight skin defects occurring during the formation of the fruit, such as silver scurfs, russets or pest damage,*
- *slight healed defects due to a mechanical cause such as hail damage, rubbing or damage from handling,*

The wording "slight defect" leaves a clear room for interpretation that needs to be described in order for the marketing standard to function effectively. Countries that grow citrus fruit in a temperate climate wanted a strict interpretation with little tolerance for peel defects. Countries with a more subtropical climate pointed out that their climate was characterized by warm, moist air and a lot of wind, leading to quite a lot of surface damage that has no effect on the eating quality. In other words, countries with a temperate climate can more easily fulfil strict requirements, and a strict interpretation would give them less competition from countries with a subtropical climate.

If it had been adopted, the interpretation that the temperate countries wanted would have led to increased use of pesticides but also to a situation in which a large part of the harvest from subtropical cultivations could not have been sold as class I, which would have barred them from the export market. These countries claimed that the old interpretation had allowed them to export their fruit, and that it had been accepted by both consumers and buyers. As usual, the discussions ended in a compromise, but with a much more permissive interpretation than the one originally promoted.

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Figure 6. Excerpt from the OECD interpretative brochure, showing the limits for surface damage caused by a fungus²⁷

4.4 What changes can lead to reduced waste?

The reasoning in previous sections suggests some conclusions that may form the basis for a discussion on what might contribute to reducing waste.

4.4.1 General changes

- Change market requirements

If marketing standards accurately reflect market requirements, then those requirements exist whether marketing standards are being applied or not. In such a case, it is not the marketing standards that have an effect on waste, but the requirements of the market. If one wants to reduce waste, it is not the marketing standards that need to change (at least not only them), but rather the requirements of the market. This is probably much more difficult to accomplish. The marketing standards can then be amended to fit the new market requirement.

- Change classification criteria

One option might be to try and convince the parties on the market to agree that certain cosmetic defects have no effect on quality and therefore should affect neither quality classification nor price. Such a change would have to be implemented internationally, since trade nowadays is a global phenomenon and standards are applied globally. In other words, the UNECE and the Codex standards would need to change, and those changes would have to be based on actual changes in what the market wants. If not, the standards will not function properly since their role is to communicate market requirements.

²⁷ OECD, 2010.

The change requires that consumers change their view on the importance of such defects (as mentioned in the previous point). This would probably take considerable information campaigns in consumer countries, and could still be hard to accomplish. This is something that retailers have already experienced, in connection with their attempts to gain acceptance for partially green citrus fruit.

- **Make marketing standards voluntary**

Even though we believe that marketing standards have little impact on waste, they do have some effect. This is true not least due to the fact that international standards are a compromise between many countries and reflect the requirements on different markets.

However, we see no reason why the EU compulsory marketing standards could not be eliminated and replaced by a voluntary application of the international standards produced mostly by the UNECE but also by Codex (mostly tropical products). This would also be in line with the Swedish political position since our EU entry. When the EU eliminated the compulsory application of 26 product-specific standards in a reform in 2007, Swedish actors chose to apply UNECE standards on a voluntary basis. There is nothing to suggest that this does not work fine. As mentioned before however, we do not believe that removing the compulsory standards would have any significant effect on waste.

However, this is not for Swedish authorities to decide. The issue is governed by EU legislation, which means that 28 Member States are involved in the decision. The EU has recently implemented a reform of the Common Market Organisation, and it did not change this aspect. This makes it likely that the eleven product-specific standards will remain at least until the next reform in 2020.

- **Eliminate misunderstandings**

When consumer requirements are based on pure misconceptions, there is an obvious need to convey correct information. As in the previous point, this may require some form of information campaign.

4.4.2 Change the balance on the market

- **Reduced supply/higher prices**

The lower the price of the products at the early stages of the distribution chain, the lower the incentive to sell the products, since the grower or the packer may not cover their costs. This may result in a situation in which low-quality products are not harvested, or are discarded during packing.

Against this background, the current problem of waste in the fruit and vegetables sector may be viewed as a result of a large production. If there is a shortage of products, market requirements change and become less picky, particularly about defects that have no effect on eating quality. This leads to higher prices for low quality produce, and it becomes profitable to sell them. However, a large volume of products for sale, and low prices of fruit and vegetables, are beneficial for consumers and promotes public health.

When prices are so low that the situation is considered a crisis, the EU agricultural policy offers support to growers. If those funds are used for supporting a situation of structural overproduction and not only during immediate crises, this can have the effect of not only cementing a structural imbalance but also of increasing waste. Restrictive use of this kind of support is therefore a way to contribute to reducing waste.

4.4.3 Concrete measures

Based on the current situation, farmers, wholesalers and retailers can take certain concrete steps to reduce waste. Some aim to increase quality during cultivation in general, or to reduce quality losses post-harvest. This would reduce waste both during cultivation and later in the distribution chain. Other measures seek to find alternative markets for products that do not meet the quality requirements of the main buyer.

4.4.3.1 *During production:*

- Further adaptation of cultivation techniques
If cultivation is adapted to the quality demanded, this would reduce waste. Measures that reduce the effect of fungi, bacteria and various pests are important to achieve good quality. During open air cultivation, using nets or adapting the sowing time are possible ways of avoiding a certain predator. Greenhouse cucumbers are replanted once or twice during the season in order to achieve a healthier product. Other measures involve pruning fruit trees in a way that lets more air in, and to remove some unripe fruits in order to allow the remaining ones to grow to a good size.
- More than one harvest
Products rarely develop at exactly the same rate even when they were planted at the same time. If the grower harvests only once, some products will be left behind since they are not sufficiently developed or mature. By harvesting more than once, a larger share of the products can be harvested. However, this only works if it is profitable.
- Planning of production
Since the decision to harvest the products or not depends on financial considerations, a measure like production planning matters for waste reduction. If too large volumes are harvested at the same time, there is a risk that prices will be so low that it does not pay to harvest the products. This means that products that are harvested several times a year, the number of harvest cycles should be adapted to expected demand.
- Sufficient cooling facilities
This measure is closely related to production planning, but is applied post-harvest. Sufficient access to cooling facilities allow growers or their producer organisations to keep the products for a certain time, and to wait for demand to improve in times of surplus supply. If this option is not available, it may cause the grower to discard the products instead, or not to harvest them.

- Swift cooling after harvest

The ageing of a product to a large extent depends on time and temperature. The product's respiration, which turns carbohydrates into carbon dioxide and water, is approximately halved when temperature is reduced by ten degrees. Swift and efficient cooling after harvest increases quality and reduces waste both at the production stage and later in the distribution chain, particularly for sensitive products like broccoli and asparagus.

Swift cooling after harvest also reduces the loss of water from the products, which is of particular importance for products with a large surface area, like leafy vegetables, that can lose moisture quickly. In addition, leafy vegetables should not lose more than some 3 per cent of their weight, since a larger moisture loss than that would cause them to lose their freshness and to become unmarketable. The lower the moisture loss during harvest and later on, the longer the products will remain marketable, and the lower the waste further down the line.

- Gentler handling during washing, trimming, etc.

All post-harvest handling causes damage and increases waste. Techniques for washing, trimming and packaging should keep developing to identify weak links in order to reduce damage to produce.

- Better packing of Swedish apples

The Swedish climate results in apples with thin peels, and this makes them extra sensitive to bruising. By packing apples on paper or plastic trays with apple-shaped depressions you can reduce bruising, and thereby also waste. Apples packed in this way can be sold either in reusable plastic crates or in paper crates, and with one or two layers of apples. The share of apples packed in this way has increased in recent years, even though it costs about SEK 1.50 more per kilo.²⁸

- Find other markets for products that do not meet the requirements of the main buyer

- Selling at an on-farm shop

Products that do not meet the requirements of the marketing standard of the buyers can be sold at an on-farm shop.

- Industrial processing

Products that do not fulfil the requirements of the marketing standards or the buyers can go to industrial processing. The processor can either be a part of the grower's own company, or be a separate entity. For carrots, a product for which as much as 25-30 per cent of all products are discarded after storage, there are several options. Carrots can be shaped into smaller, ready-to-eat carrots, or they can be peeled, cut and sold to institutional kitchens, or be peeled, trimmed and crushed in order to be sold as an ingredient to the food industry.

- Find out if windfalls could go to processing

Today, quality requirements do not allow windfalls to be used even for industrial processing, since the mould toxin patulin may form on such

²⁸ Lars-Olof Börjesson, verbal communication

fruit. Patulin formation is linked to mould. However, windfalls are not necessarily affected by mould, so there is no absolute correlation between windfalls and patulin. The deciding factor ought to be if the fruit has begun to decay or not. France uses windfalls for cider production, so they apparently take a somewhat different view than Sweden. This means that it could be worth looking into if undamaged windfalls could go to processing.

- Selling products for home processing

Products that do not meet the requirements of the marketing standards of the buyers can be packed separately and sold by retailers, given that they are clearly labelled as products intended for home processing. This option is used only to a very small extent, since prices are seen as too low for it to be profitable. However, one example is sale of so-called "Norrland apples". They are boxes that contain 10 kg of mixed varieties of apples that are a little too small or too large, and/or varieties that are on their way out but which are of good quality in all other ways. However, they are only sold to the northern part of Sweden, since people there are more likely to make their own apple sauce.

4.4.3.2 *Wholesalers and importers*

- Reclassification

Batches that are found not to meet the requirements of the marketing standards either upon arrival or after having been stored at the wholesaler, can be reclassified to a lower class and then sold. However, this only works if the retailers and the consumers are prepared to buy class II products.

- Correct storage

Products should be kept at a suitable temperature and in air with appropriate humidity. Products that are sensitive to ethylene should be kept apart from products that produce ethylene.

- Avoid using B pallets and single-use pallets

B pallets have been used and repaired, and single-use pallets are made of weaker wood. Such pallets break more easily, which can cause entire pallets to collapse, scattering boxes and ending up with products having to be discarded.

- Swift turnover

The quicker the turnover, the better the quality will be, and this reduces waste. This means that companies should not buy too large consignments since that causes products to be kept for too long.

- Find other markets for products that do not meet the requirements of the main buyer

- Industrial processing

Products that do not fulfil the requirements of the marketing standards or the buyers can go to industrial processing.

- Selling products for home processing

Products that do not meet the requirements of the marketing standards of the buyers can be packed separately and sold by retailers, given that they are clearly labelled as products intended for home processing.

4.4.3.3 Retailers

- Reclassification

Products that are found not to meet the requirements of the marketing standards either upon arrival or after having been stored for some time, can be reclassified to a lower class and then sold. However, this only works if the supermarket will consider selling class II products and that consumers are prepared to accept products with some defects.

- Correct storage

Products should be kept at the right temperature and in air that has the right degree of moisture. Products that are sensitive to ethylene should be kept apart from products that produce ethylene. This may be difficult to accomplish in a supermarket, but it should still be an objective to strive towards.

- Swift turnover

The quicker the turnover, the better the quality will be, and this reduces waste. This means that companies should not buy too large batches since that causes products to be kept for too long.

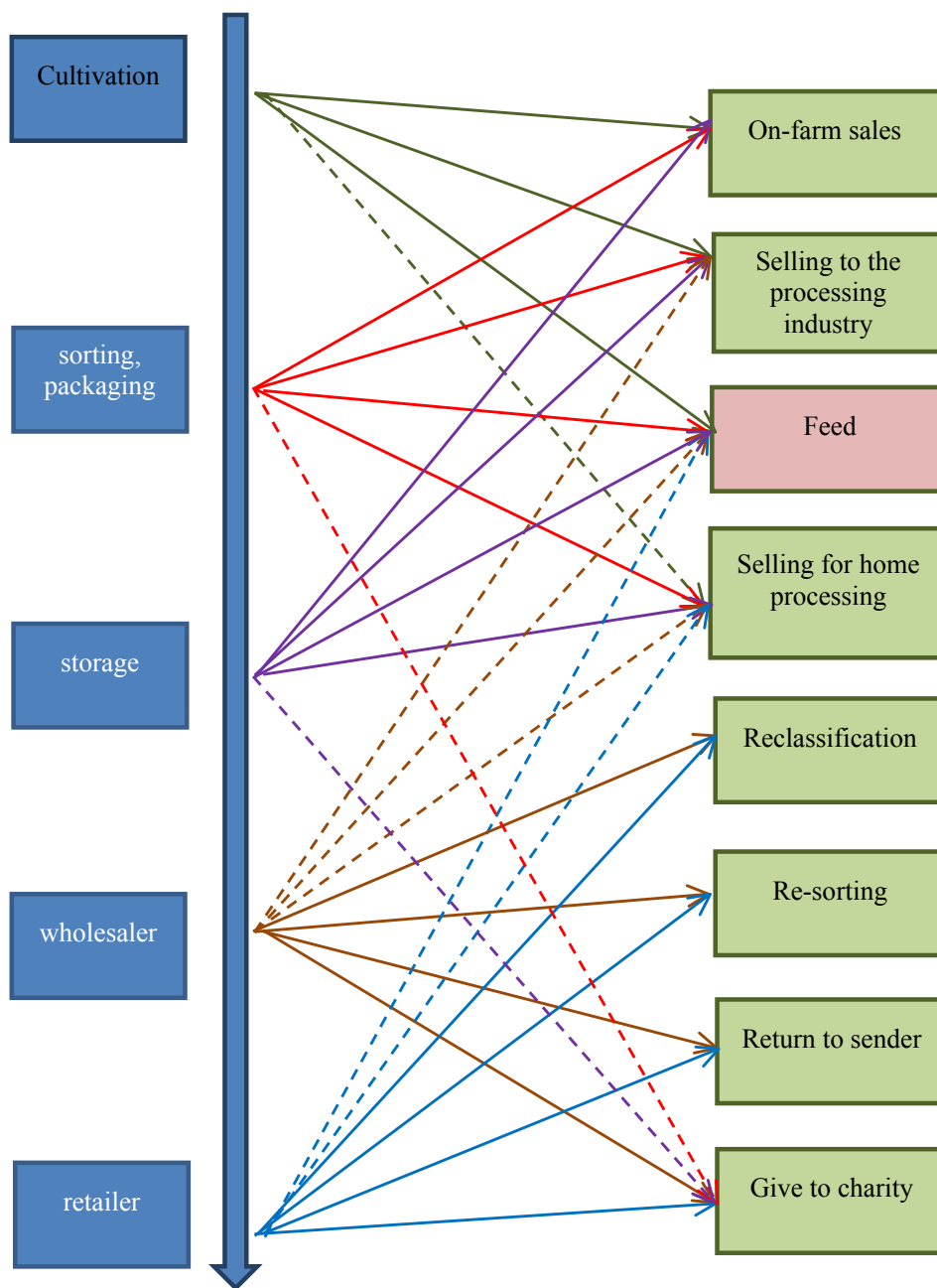
- No big piles of products

Big piles of products result in heavy bruising, which means that certain products will be left behind and will have to be discarded. By selling one box at a time, this problem is reduced.

- Find other markets for products that do not meet the requirements of the main buyer

- Selling products for home processing

Products that do not meet the requirements of the marketing standards of the buyers can be packed separately and sold by retailers, given that they are clearly labelled as products intended for home processing.



Dashed lines show that the opportunity is not used in Sweden, or only used to a very limited extent. Products sold as feed count as waste, since they are not used for human consumption.

Figure 7. Possible uses for products that do not meet the requirements of the marketing standards.

5 Concluding remarks

In our view the marketing standards have only a limited effect on food waste in the Swedish fruit and vegetable sector. This is because the major retailers, which handle some 80 per cent of all food sold in Sweden, rarely buy products of lower quality than class I. The lowest quality sold is therefore the lower limit of class I, and not the lower limit of the marketing standards, which is the lower limit of class II. A UK study in 2003²⁹ reached a similar conclusion, namely that the quality requirements of the retailers are higher than the lowest quality accepted by the marketing standards.

It would also be a good thing if consumers were to realise that some of the requirements and preferences that they apply to fruit and vegetables have no effect whatsoever on eating quality. However, that is no easy task. In addition, retailers would have to help with it, since consumer preferences probably evolve in a form of synergy with supermarkets.

At the same time, a market exists outside the main retailers, and this is made up of market trade and on-farm shops. Products in on-farm shops do not have to meet the marketing standards, so they are not a limiting factor in that case. Market trade is treated on equal footing with retailers, which means that such products have to comply with marketing standards – which are compulsory throughout the EU. In our view, if there is a demand for certain products in market trade, such products are provided. This means that in practice, the marketing standards have no significant limiting effect in this trade either.

We see no problem with making it voluntary to apply marketing standards. The Swedish market worked well with voluntary standards until we joined the EU in 1995, and there is no reason to believe that it would not work well even in the future. At the same time, we do not believe that such a change would have any significant effect on waste, since Swedish retailers apply stricter requirements than the marketing standards. Other standards would apply instead, and it is possible that these would be stricter and lead to an increase in waste.

However, marketing standards ought to be reviewed to ensure that they reflect market requirements, and above all to make sure that they do not prohibit the sale of products for which there is a demand. Therefore, both the eleven product-specific marketing standards applied by the EU and the standards produced by the UNECE and the Codex should be reviewed with this aspect in mind.

Many measures that have nothing directly to do with marketing standards could be taken to reduce waste. A large part of the waste is caused by pests, fungi and bacteria. Research efforts to produce resistant varieties and to develop cultivation methods that result in less damage would be of great importance for reducing waste, and would also make things easier for growers. Other ways to reduce waste include improved harvest machinery, equipment for washing, sorting and packaging that minimises the effect on products, as well as increased capacity and techniques for cooling and storage facilities using controlled atmosphere. Finally, the products need to be handled better by the supermarkets. Big piles of products exposed in room temperature of course reduce quality significantly and increase waste.

²⁹ ADAS, 2003.

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Verbal communications

The subject of the report has been discussed with the people below in a free form. This means that those conversations were not based on any questionnaire or uniform structure. This is why the text only contains a limited number of direct references linked to this data.

Catherine Ballandras, Direction Generale de la Concurrence, de la Consommation et la Repression des Fraudes, Frankrike.

Anette Borgström, advisor Mellansvenska Odlare ekonomisk förening.

Lars-Olof Börjesson, VD Äppelrikt ekonomisk förening, Sverige.

Ulrike Bickelmann, Head of Inspection service, Bundesanstalt für Landwirtschaft und Ernährung, Tyskland.

Marianne Härning-Nilsson, CEO Mariannes Farm.

Ian Hewett, Regional Horticultural Marketing Inspector, Royal Paying Agency, Storbritannien.

Hans Jönsson, Affärsutveckling, Everfresh AB.

Dorian LaFond, International Standards Coordinator AMS, Fruit and vegetable programs, US Department of Agriculture, USA.

Per Nordmark, chairman Sydgrönt ekonomisk förening.

Anna Paganus, quality coordinator fruit and vegetables, ICA Sverige.

Design and content of the standards

The fruit and vegetable standards developed by the UNECE, the Codex and the EU all follow the same basic design. The UNECE standard layout for marketing standards on fresh fruit and vegetables are in Annex 2.

I. Definition of produce

This defines the product in question and gives its name both in the relevant language and in Latin. It also clarifies that products intended for processing are not comprised by the standard.

II. Provisions concerning quality

The provisions concerning quality have three parts: minimum requirements, maturity requirements, and a classification into two or three quality classes. Not all marketing standards contain maturity requirements, since they are not relevant for vegetables that do not have any real maturity process.

A. Minimum requirements

The minimum requirements comprise basic quality requirements, for instance that the products must be whole, clean, and sound, and free from damage caused by pests, fungi or mould. Batches may only contain a limited number of products that do not meet the minimum requirements; the tolerance is between 0.5 and 2.0 per cent depending on the quality class.

B. Maturity requirements

This section clarifies how mature the products have to be. For fruits that can continue to ripen after being harvested, it is clarified that they have to be sufficiently developed in order for the ripening process to continue, and for fruits that do not continue to ripen after harvest it is clarified what requirements apply.

C. Classification

Products are divided into two quality classes (class I and II), or three (class Extra, class I and class II). Requirements vary depending on the class.

- Class Extra comprises products that are close to perfect, both as regards their external appearance and their inner quality. There is little tolerance for deviations from the standard.
- Class I comprises products of very good quality, both external and internal, that have all the characteristics a consumer could expect of them. However, requirements on external quality are not as strict as for class Extra, and there is slightly more tolerance for deviations.
- Class II comprises products of good eating quality as regards taste and texture that have all the characteristics a consumer could expect from them. However, requirements on external quality are considerably lower than for the other two classes, and larger deviations are tolerated.

III. Provisions concerning sizing

Provisions concerning sizing may comprise a minimum size, and in some cases a maximum size, in case size has an effect on quality. There may also be guidelines on sizing that either divide the products into size categories, or that state the largest permitted difference between the largest and the smallest product in a box.

IV. Provisions concerning tolerances

Provisions on tolerances are divided into tolerances for diverging from the classification requirements (five per cent in class Extra and ten per cent in class I and II), and for diverging from sizing requirements (ten per cent in all quality classes).

V. Provisions concerning presentation

Provisions concerning presentation comprise requirements that the products are to be uniform as regards origin, variety and size (if products are sized), and that their packaging must be good for that purpose.

VI. Provisions concerning marking

Marking requirements always include the packer or shipper, country of origin and quality class. Sometimes the variety also has to be mentioned, as well as the size (if the products are sized).

**STANDARD LAYOUT FOR UNECE
STANDARDS ON FRESH FRUIT AND
VEGETABLES
2011**

The present revised Standard Layout has been revised and adopted at the sixty-seventh session of the Working Party.



UNITED NATIONS
New York and Geneva, 2011

STANDARD LAYOUT FOR UNECE STANDARDS

Standard layout for UNECE standards concerning the marketing and commercial quality control of fresh fruit and vegetables

In the text the following conventions are used:

{text}: For text which explains the use of the Standard Layout. This text does not appear in the standards.

<text>: For optional texts or text for which several alternatives exist, depending on the products.

UNECE Standard FFV-*{code of produce}*

concerning the marketing and commercial quality control of {name of produce}

I. Definition of produce

This standard applies to *{name of produce}* of varieties (cultivars) grown from {Latin botanical reference *in italics* followed where necessary by the author's name} to be supplied fresh to the consumer, *{name of produce}* for industrial processing being excluded.

{According to the International Code of Botanical Nomenclature the name of taxon whose rank is lower than species (e.g. variety, subspecies, form) should be followed only by the name of author of the lowest rank. Example: *Apium graveolens* L. but *Apium graveolens* var. *dulce* (Mill.) Pers. (without letter L. after *Apium graveolens*).

{Additional provisions concerning the definition of the produce may be included under this heading}

II. Provisions concerning quality

The purpose of the standard is to define the quality requirements for *{name of produce}* at the export-control stage after preparation and packaging.

However, if applied at stages following export, products may show in relation to the requirements of the standard:

a slight lack of freshness and turgidity

<for products graded in classes other than the “Extra” Class,> a slight deterioration due to their development and their tendency to perish.

The holder/seller of products may not display such products or offer them for sale, or deliver or market them in any manner other than in conformity with this standard. The holder/seller shall be responsible for observing such conformity.

A. Minimum requirements

In all classes, subject to the special provisions for each class and the tolerances allowed, the *{name of produce}* must be:

intact {depending on the nature of the produce, a deviation from the provision is allowed}

sound; produce affected by rotting or deterioration such as to make it unfit for consumption is excluded

clean, practically free of any visible foreign matter {with regard to traces of soil, a deviation from this provision is allowed, depending on the nature of the produce}

practically free from pests

<free from damage caused by pests affecting the flesh>

<practically free from damage caused by pests>

free of abnormal external moisture

free of any foreign smell and/or taste.

{Additional provisions may be made for specific standards, depending on the nature of the produce}.

<The produce must be sufficiently developed, and display satisfactory ripeness, depending on the nature of the produce.>

The development and condition of the *{name of produce}* must be such as to enable them:

to withstand transportation and handling

to arrive in satisfactory condition at the place of destination.

B. Maturity requirements

{To be drawn up, depending on the produce}.

C. Classification

{Name of produce} are classified in two or three classes, as defined below:³⁰

(i) "Extra" Class

{Name of produce} in this class must be of superior quality. They must be characteristic of the variety and/or commercial type.

They must be:

.....
{Provisions, depending on the nature of the produce}.

They must be free from defects, with the exception of very slight superficial defects, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package.

(ii) Class I

{Name of produce} in this class must be of good quality. They must be characteristic of the variety and/or commercial type.

They must be:

³⁰ For those standards where it does not appear necessary to establish a classification, only the minimum requirements apply.

.....
{Provisions, depending on the nature of the produce}.

The following slight defects, however, may be allowed, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package:

- a slight defect in shape
- slight defects in colouring
- slight skin defects.

.....
{Add additional defects allowed, depending on the nature of the produce}.

(iii) Class II

This class includes *{name of produce}* that do not qualify for inclusion in the higher classes but satisfy the minimum requirements specified above.

They must be:

.....
{Provisions, depending on the nature of the produce}.

The following defects may be allowed, provided the *{name of produce}* retain their essential characteristics as regards the quality, the keeping quality and presentation:

- defects in shape
- defects in colouring
- skin defects.

.....
{Add additional defects allowed, depending on the nature of the produce}.

III. Provisions concerning sizing

Size is determined by *{diameter, length, weight, circumference, depending on the nature of produce}*.

The minimum size shall be

<To ensure uniformity in size, the range in size between produce in the same package³¹ shall not exceed>

<There is no sizing requirement for *{name of produce, variety, commercial type or class depending on the nature of produce}*.>

{Add provisions on minimum and maximum sizes and size range, depending on the nature of produce, the variety, the commercial type and possibly the individual classes}.

³¹ {Definitions: The term "packages" covers "sales packages" and "prepackages".

Packages are individually packaged part of a lot, including contents. The packaging is conceived so as to facilitate handling and transport of a number of sales packages or of products loose or arranged, in order to prevent damage by physical handling and transport. The package may constitute a sales package. Road, rail, ship and air containers are not considered as packages.

Sales packages are individually packaged part of a lot, including contents. The packaging of sales packages is conceived so as to constitute a sales unit to the final user or consumer at the point of purchase.}

IV. Provisions concerning tolerances

At all marketing stages, tolerances in respect of quality and size shall be allowed in each lot for produce not satisfying the requirements of the class indicated.

A. Quality tolerances

(i) "Extra" Class

A total tolerance of 5 per cent, by number or weight, of *{name of produce}* not satisfying the requirements of the class but meeting those of Class I is allowed. Within this tolerance not more than 0.5 per cent in total may consist of produce satisfying the requirements of Class II quality.

{Add possible tolerances for individual defects, depending on the nature of the produce}.

(ii) Class I

A total tolerance of 10 per cent, by number or weight, of *{name of produce}* not satisfying the requirements of the class but meeting those of Class II is allowed. Within this tolerance not more than 1 per cent in total may consist of produce satisfying neither the requirements of Class II quality nor the minimum requirements, or of produce affected by decay.

{Add possible tolerances for individual defects, depending on the nature of the produce}.

(iii) Class II

A total tolerance of 10 per cent, by number or weight, of *{name of produce}* satisfying neither the requirements of the class nor the minimum requirements is allowed. Within this tolerance not more than 2 per cent in total may consist of produce affected by decay.

{Add possible tolerances for individual defects, depending on the nature of the produce}.

B. Size tolerances

For all classes {for individual standards, however, different provisions according to the individual classes may be laid down}: a total tolerance of 10 per cent, by number or weight, of *{name of produce}* not satisfying the requirements as regards sizing is allowed.

{Possible provisions concerning admissible limits of deviations for sized or unsized produce}.

V. Provisions concerning presentation

A. Uniformity

The contents of each package² <(or lot for produce presented in bulk in the transport vehicle)> must be uniform and contain only *{name of produce}* of the same origin, quality and size <(if sized)>.

{In addition, for individual standards, uniformity concerning variety and/or commercial type may be laid down, depending on the nature of the produce}.

{Other possible provisions, depending on the nature of the produce}.

.....
<However, a mixture of *{name of produce}* of distinctly different <species> <varieties> <commercial types> <colours> may be packed together in a <package>

<sales package>, provided they are uniform in quality and, for each <species> <variety> <commercial type> <colour> concerned, in origin.>

{If specific requirements, including net weight limits of sales packages, are needed, they can be added within the context of individual standards.}

The visible part of the contents of the package² <(or lot for produce presented in bulk in the transport vehicle)> must be representative of the entire contents.

B. Packaging

{*Name of produce*} must be packed in such a way as to protect the produce properly.

The materials used inside the package² must be clean and of a quality such as to avoid causing any external or internal damage to the produce. The use of materials, particularly of paper or stamps bearing trade specifications, is allowed, provided the printing or labelling has been done with non-toxic ink or glue.

Stickers individually affixed to the produce shall be such that, when removed, they neither leave visible traces of glue nor lead to skin defects.

Packages² <(or lots for produce presented in bulk in the transport vehicle)> must be free of all foreign matter.

VI. Provisions concerning marking

Each package³² must bear the following particulars, in letters grouped on the same side, legibly and indelibly marked, and visible from the outside:

<For {*name of produce*} transported in bulk (direct loading into a transport vehicle) these particulars must appear on a document accompanying the goods, and attached in a visible position inside the transport vehicle.>

A. Identification

Packer and/or dispatcher/shipper:

Name and physical address (e.g. street/city/region/postal code and, if different from the country of origin, the country) or a code mark officially recognized by the national authority³³.

B. Nature of produce

Name of the produce if the contents are not visible from the outside

<-name of the variety>

<The name of the variety can be replaced by a synonym. A trade name³⁴ can only be given in addition to the variety or the synonym>

<-name of the variety (optional)>

<-name of the variety. In the case of a mixture of {*name of produce*} of distinctly different varieties <species>, names of the different varieties <species>.>

³² These marking provisions do not apply to sales packages presented in packages.

³³ The national legislation of a number of countries requires the explicit declaration of the name and address. However, in the case where a code mark is used, the reference “packer and/or dispatcher (or equivalent abbreviations)” has to be indicated in close connection with the code mark, and the code mark should be preceded by the ISO 3166 (alpha) country/area code of the recognizing country, if not the country of origin.

³⁴ A trade name can be a trade mark for which protection has been sought or obtained or any other commercial denomination.

<“Mixture of *{name of produce}*”, or equivalent denomination, in the case of a mixture of distinctly different commercial types and/or colours of *{name of produce}*. If the produce is not visible from the outside, the commercial types and/or colours and the quantity of each in the package must be indicated.>

{Add name of the commercial type, depending on the nature of the produce}.

C. Origin of produce

Country of origin³⁵ and, optionally, district where grown, or national, regional or local place name.

<In the case of a mixture of distinctly different varieties <species> of {name of produce} of different origins, the indication of each country of origin shall appear next to the name of the variety <species> concerned.>

<In the case of a mixture of distinctly different commercial types and/or colours of {name of produce} of different origins, the indication of each country of origin shall appear next to the name of the commercial type and/or colour concerned.>

D. Commercial specifications

Class

Size <(if sized)>

{Add other possible particulars, depending on the nature of the produce}.

E. Official control mark (optional)

³⁵ The full or a commonly used name should be indicated.

{Depending on the nature of the produce, a list of varieties can be included as an annex.}

Annex I

<Non-Exhaustive><Exhaustive> List of *{name of produce}* Varieties

Some of the varieties listed in the following may be marketed under names for which trademark protection has been sought or obtained in one or more countries. Names believed by the United Nations to be varietal names are listed in the first column. Other names by which the United Nations believes the variety may be known are listed in the second column. Neither of these two columns is intended to include trademarks. References to known trademarks have been included in the third column for information only. The presence of any trademarks in the third column does not constitute any licence or permission to use that trademark – such licence must come directly from the trademark owner. In addition, the absence of a trademark in the third column does not constitute any indication that there is no registered/pending trademark for such a variety. For labelling requirements please refer to section VI of the standard.³⁶

<i>Variety</i>	<i>Synonyms</i>	<i>Trademarks</i>	<i>{Other information, depending on the produce}</i>

³⁶ Some of the varietal names listed in the first column may indicate varieties for which patent protection has been obtained in one or more countries. Such proprietary varieties may only be produced or traded by those authorized by the patent holder to do so under an appropriate licence. The United Nations takes no position as to the validity of any such patent or the rights of any such patent holder or its licensee regarding the production or trading of any such variety.

The United Nations endeavoured to ensure that no trademark names are listed in columns 1 and 2 of the table. However, it is the responsibility of any trademark owner to notify the United Nations promptly if a trademark name has been included in the table and to provide the United Nations (see address below) with an appropriate varietal, or generic name for the variety, as well as adequate evidence ownership of any applicable patent or trademark regarding such variety so that the list can be amended. Provided that no further information is needed from the trademark holder, the Working Party on Agricultural Quality Standards will change the list accordingly at the session following receipt of the information. The United Nations takes no position as to the validity of any such trademarks or the rights of any such trademark owners or their licensees.

Agricultural Standards Unit
Trade and Timber Division
United Nations Economic Commission for Europe
Palais des Nations, CH-1211 Geneva 10, Switzerland
E-mail: agristandards@unece.org

{In the case of lists of varieties where only very few trademarks appear, the list may be presented in the annex as follows (inclusion of references to trade names in footnotes)}

Annex II

<Non-Exhaustive><Exhaustive> List of *{name of produce}* Varieties

Some of the varieties listed in the following may be marketed under names for which trademark protection has been sought or obtained in one or more countries. Names believed by the United Nations to be varietal names are listed in the first column. Other names by which the United Nations believes the variety may be known are listed in the second column. Neither of these two columns is intended to include trademarks. References to known trademarks have been included in footnotes for information only. The absence of a trademark in the footnotes does not constitute any indication that there is no registered/pending trademark for such a variety.³⁷

<i>Variety</i>	<i>Synonyms</i>	<i>{Other information, depending on the produce}</i>
Variety "xyz"		

Adopted 1985
Last revised 2011

³⁷ Some of the varietal names listed in the first column may indicate varieties for which patent protection has been obtained in one or more countries. Such proprietary varieties may only be produced or traded by those authorized by the patent holder to do so under an appropriate licence. The United Nations takes no position as to the validity of any such patent or the rights of any such patent holder or its licensee regarding the production or trading of any such variety.

The United Nations endeavoured to ensure that no trademark names are listed in the table. However, it is the responsibility of any trademark owner to notify the United Nations promptly if a trademark name has been included in the table and to provide the United Nations (see address below) with an appropriate varietal, or generic name for the variety as well as adequate evidence ownership of any applicable patent or trademark regarding such variety. Provided that no further information is needed from the trademark holder, the Working Party on Agricultural Quality Standards will change the list accordingly at the session following receipt of the information. The United Nations takes no position as to the validity of any such trademarks or the rights of any such trademark owners or their licensees.

Fruit and vegetables	EU	UNECE	Codex	Interpretative brochure
Annonas		X		
Apples	X	X	X	OECD
Apricots		X		OECD
Artichokes		X		
Asparagus		X	X	OECD
Aubergines		X		
Avocados		X	X	OECD
Bananas (green)	X		X	
Beans		X		OECD
Berry fruits		X		
Broccoli		X		OECD
Brussels sprouts		X		
Cape Gooseberries			X	
Carambola			X	
Carrots		X		OECD
Cauliflowers		X		
Ceps		X		
Chanterelles		X	X	
Chayote			X	
Cherries		X		Work in progress
Chikory (Witloof)		X		OECD
Chilli pepper		X	X	UNECE
Chinese cabbage		X		Work in progress
Citrus fruit	X	X		OECD
Cucumber		X		OECD
Cultivated mushrooms		X		OECD
Dates			X	
Fennel		X		
Fresh figs		X		Work in progress
Garlic		X		Work in progress
Grapefruit			X	
Guava			X	
Headed cabbage		X		
Kiwi fruit	X	X		OECD
Leafy vegetables		X		
Leek		X		
Lettuce	X	X		OECD
Lime			X	
Litchi			X	
Longans			X	
Mangoes		X	X	OECD
Mangosteen			X	
Melons		X		Work in progress
Mexican lime			X	
Mini maize			X	
Onions		X		OECD
Oranges			X	
Papaya			X	
Peaches and nectarines	X	X		OECD
Pears	X	X		OECD
Peas		X		
Pineapple		X	X	UNECE
Pitahayas			X	

Plums		X		OECD
Pomegranate			X	
Potatoes		X		OECD
Prickly pears			X	
Pummelos			X	
Rambutan			X	
Rhubarb		X		
Ribbed celery		X		
Root vegetables		X		
Shallots		X		Work in progress
Squash		X		
Strawberries	X	X		OECD
Sweet cassava			X	
Sweet chestnuts		X		
Sweet pepper	X	X		UNECE
Table grapes	X	X	X	OECD
Tamarillo			X	
Tannia			X	
Tomatoes	X	X	X	OECD
Truffles		X		
Watermelon		X		OECD

Publications in the same field

1. Kartläggning av matsvinnet i primärproduktionen. Franke, U. m.fl. Tema Nord 2013:581.
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4. Reducing Food Waste. Obstacles experienced in legislation and regulations. LEI report. Warts, Y. m.fl. 2011.

The rapport can be ordered from

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