European Cooperative Programme for Plant Genetic Resources

ECP/GR

ECPGR Characterization and Evaluation Descriptors for Pear Genetic Resources

Pear (*Pyrus communis*)

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The Programme, which is entirely financed by the member countries, is overseen by a Steering Committee composed of National Coordinators nominated by the participating countries. The Coordinating Secretariat is hosted by the Alliance of Bioversity International and CIAT.

The Programme operates through Working Groups composed of pools of experts nominated by the National Coordinators. The ECPGR Working Groups deal with either crops or general themes related to plant genetic resources (documentation and information, and *in situ* and on-farm conservation). Members of the Working Groups carry out activities based on specific ECPGR objectives, using ECPGR funds and/or their own resources.

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Cover illustration: Diverse pear cultivars. Courtesy of © M. Lateur, Centre Wallon de Recherches Agronomiques (CRA-W), Belgium.

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Introduction

Developing standards to collect and share information about plant genetic resources is vital for their conservation and use by farmers, gardeners, scientists, conservationists and breeders.

In recent years, the ECPGR *Malus/Pyrus* Working Group highlighted the need to synthesize, harmonize and prioritize an agreed set of characterization and evaluation descriptors for *Malus/Pyrus* cultivated species (Lateur *et al*. 2006, Lateur *et al.* 2013), and committed to filling this need. Common protocols and descriptors were consequently adapted, initially by a task force formed by representatives of the *Malus/Pyrus* Working Group (M. Lateur, D. Szalatnay, E. Dapena, M. Kellerhals). Further on, in the framework of an ECPGR Grant Scheme Activity named 'Common ECPGR protocols and tools available for Characterization & Evaluation of *Malus/Pyrus* genetic resources', and supported by the Federal Ministry of Food and Agriculture, Germany, it was planned to finalize a new updated version of the former *Descriptor List for Pear (*Pyrus*)* published nearly 40 years ago.
This publication brings all the above efforts together and includes enhanced descriptions of methods/protocols and technical practical information. As far as possible, it was attempted to retain descriptors already in use, and many of the descriptors proposed are the same as previously published by, or adapted from ECPGR, UPOV, CPVO and/or *Obst-Deskriptoren NAP – Descripteurs de Fruits PAN* (Szalatnay, 2006). Further descriptors are from protocols already developed and in use by collection curators, and a small number of novel descriptors have been added where no suitable descriptor was available.

Genetic resources, by their nature, contain a wide diversity of traits. Scales must be sufficiently open to include this range. A general rule has been to use 1–9 scales with extreme classes (1 and 9) described as 'Extremely…', which should be taken to mean outside of what is generally known. To maximize the accuracy of a trait description, in many tables, it is recommended to use the intermediate class types referenced in the descriptor tables as 'X'.

Describing colour can be challenging, and illustrations are presented in the document thanks to the work of Szalatnay (2006). It is recommended, when possible, to control the judgement of colour against a standard colour chart such as the Royal Horticultural Society Colour Chart, and reference to this is either included or needs to be included in due course in line with UPOV (2019).

Even for characterization traits, variability is observed among fruits, among sites and across years. It is therefore ideal to collect data over a sufficiently long time to be able to show the variability of the character and to define a 'median' relative value for each trait.

Most descriptors are based on comparison to reference cultivars. However, in some cases, illustrations or absolute values have been added for further clarity. For most descriptors, it is recommended that the list of reference cultivars is extended so that, for each category, at least one is available for comparison.

One very important objective in standardizing descriptors is to be able to compare and analyze data from different collections, and it is crucial to clearly describe the methodology used for each descriptor. To aid with the comparison across different collections, it is important to record experimental methods, numbers of replicates, ages of trees, rootstocks and management scheme (e.g. fungicide application), and to include reference cultivars as far as possible. Climatic data such as mean rainfall for each season can also be important to include.

It is hoped that the descriptors herein will allow the potential ranking of accessions through relative classification; ranking will obviously need to be applied within specific contexts.

It is recommended that field observations on descriptions and/or descriptors should be maintained for later reference and/or consideration.

Further information on the concepts of crop descriptors is downloadable from:

- https://cgspace.cgiar.org/handle/10568/56589

Online information on pear descriptors can also be found at:

- https://cpvo.europa.eu/sites/default/files/documents/pyrus_communis_1.pdf
- https://hdl.handle.net/10568/72906
- http://www.cpc-skek.ch/fileadmin/pdf/NAP_Beschreibungshandbuecher/deskriptoren-handbuch_nap.pdf

Methods and prioritized descriptors for pear (*Pyrus*)

The aim of the below is to recommend a range of descriptors to successfully describe and discriminate between key characters in most accessions. Ideally, characters should meet the criteria of being:

- Highly stable over time with low interaction with environmental factors
- Highly polymorphic
- Easy to score in practice
- Able to combine characterization and agronomic evaluation value where possible.

The proposed list was mostly compiled using:

- *Pear Descriptors*, IBPGR (Thibaut, Watkins and Smith, 1983) – Referenced in the text as '**IBPGR**'
- *Protocol for distinctness, uniformity and stability tests* – Pyrus communis – *PEAR*, CPVO-TP/15/1 Final (27/03/2003) – Referenced in the text as **'PVO**'
- UPOV Guidelines for the conduct of tests for distinctness, uniformity and stability (Pear – *Pyrus communis*): TG/15/3 (2000)
- *Obst-Deskriptoren NAP – Descripteurs de Fruits PAN* (Szalatnay, 2006).

A priority ranking of the descriptors is included. It is acknowledged that capability will depend on time and resources. The primary characterization and evaluation traits are recommended for prioritization. First-priority descriptors are indicated in the document with '**Priority 1**'; second- and third-priority descriptors with '**Priority 2/3**'. Second- and third-priority descriptors represent useful tools that can be used by curators who have the capacity to do further evaluation and/or characterization work.

Since many scores are relative, it is important to have representatives from a minimum set of common reference cultivars (ideally, a minimum of 2/3) in each characterization/evaluation site. Recommended cultivars for general comparison are listed below and are based on a survey of the members of the ECPGR *Malus/Pyrus* Working Group:

- Abate Fetel (syn. Abbé Fétel)
- Beurré Alexandre Lucas (syn. Alexander Lucas, Alexander Lucas Butterbirne, Lucasova Maslovka)
- Beurré de Mérode (syn. Double-Philippe, Doyenné Boussoch)
- Beurré d'Hardenpont (syn. Glou Morceau, Beurré d'Arenberg – in France, Ardenpont d'Inverno, Butirra d'Hardenpont d'Inverno, Hardenpontova Maslovka, Hardenpont's Winterbutterbirne)
- Beurré Hardy (syn. Hardy, Gellerts Butterbirne, Butirra Hardy)
- Beurré Superfin (syn. Butirra Sopraffina, Hochfeine Butterbirne)
- Blanquilla (syn. Spadona)
- Clapp's Favourite
- Comtesse de Paris (syn. Gräfin von Paris, Paris)
- Conference
- Doyenne du Comice
- Durondeau (syn. Tongre, Poire de Tongre, Tongern, Beurré Durondeau)
- Kontoula
- Kristalli
- Légipont (syn. Fondante de Charneux, Köstliche von Charneux)
- Louise Bonne d'Avranches
- Nec Plus Meuris (syn. Beurré d'Anjou, Anjou Pear, Butirra d'Anjou)

- Nouveau Poiteau (syn. Neue Poiteau, Patawinka Poiteau)
- Précoce de Trévoux (syn. Frühe aus Trévoux)
- Williams' Bon Chrétien (syn. Bartlett, Williams, Williams Christbirne)

General notes on methodology for characterization

Data should be recorded on representative trees. Ideally, data should be recorded in representative years.

Extreme climatic conditions such as high spring temperature, severe spring frost or hail are known to affect floral phenology and fruit set/quality.

Ideally, data from several **representative** years should be recorded before accessions can be fully classified.

All recorded dates should be transformed into number of days from the first of January. Phenological classifications can then be expressed as '+' or '–' (X) day differences from the reference cultivars classified in the medium period.

It is important to organize training for technicians and field workers who will perform the evaluation. It is recommended to check the reproducibility of data (between data collected on the same object by different observers) and the repeatability (between observations made by the same observer at different times).

1. Flowers

Assessment of trees two to three times per week is generally recommended in order to observe the correct moment when flowers open. The primary stages which need at least to be observed are: E2 (BCCH: 59), F (BCCH: 61), F2 (BCCH: 65) and H (BCCH: 69), (according to Fleckinger and Meier, 2001 – **Figure 1)**. For further detail it is recommended to follow the BBCH flowering stages codes (Anonym, 1989, Meier, 2001). As a general rule, the assessment of flowers should not include those appearing on one-year shoots.

Some cultivars tend to produce a second flowering phase a few months after the spring flowering period. The intensity of this flowering is much less important, but incidence represents a risk of infection by fire blight (*Erwinia amylovora*). Independent descriptors relating to secondary flowering are proposed.

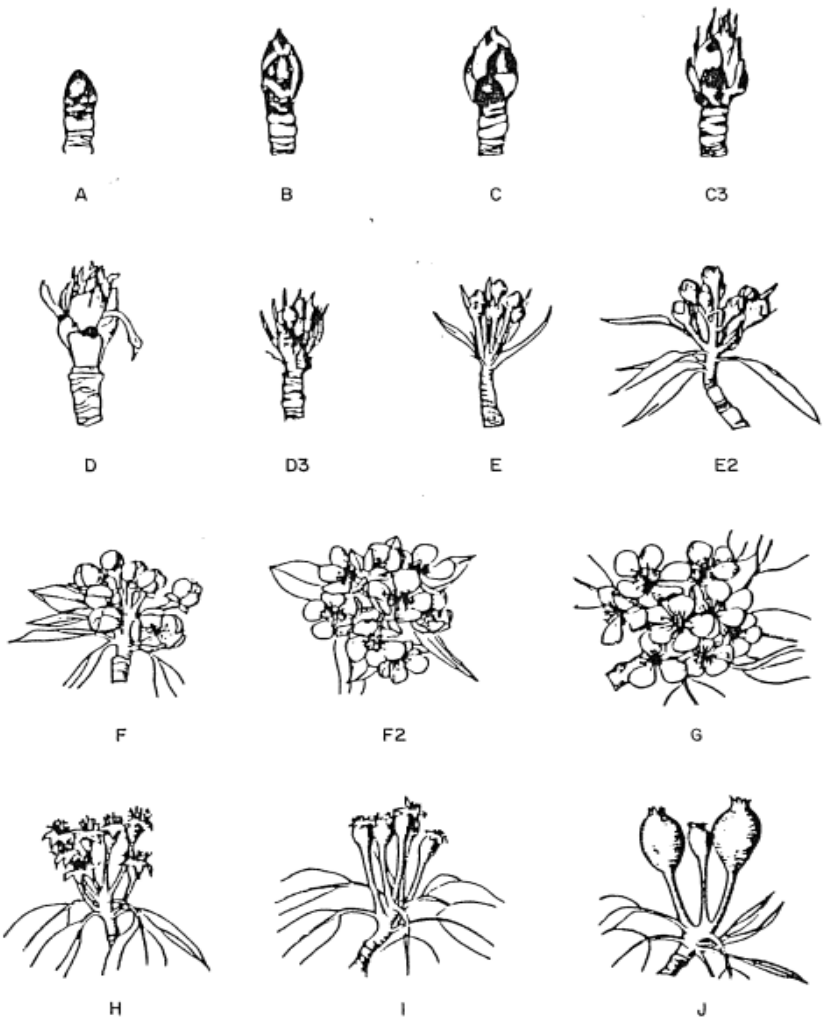


Figure 1. Fleckinger's phenological flower stages for pear.

1.1 Flowering phenology (*Priority 1*)

When flowering intensity is very low (fewer than 5% of the buds are flower buds), it is not representative to evaluate the flowering season. It is useful to note and/or assess the flowering intensity of the trees by using the assessment key defined in **Table 1**. The relative flowering season of a cultivar (**Table 2**) can then be assessed by comparison against the flowering period of reference cultivars. It is recommended that for standardization, reference cultivars like Beurré Hardy, Conference and/or Williams Bon Chrétien need to be considered as a central point for all areas. For this comparison; the reference flower stage can be either 'F' (BCCH: 61), or 'F2' (BCCH: 65).

Table 1. Flowering intensity (Lateur and Populer, 1996)

State	Flowering intensity	Field observations
1	No flower	Absence of any flower
2	Extremely low	Flower clusters represent up to 5% of all buds
3	Low	Flower clusters represent approx. 10% of all buds
4	Low to medium	X
5	Medium	Flower clusters represent approx. 30% of all buds
6	Medium to high	X
7	High	Flower clusters represent approx. 50% of all buds
8	High to extremely high	X
9	Extremely high	Over 90% of all buds are floral

'X': Intermediate rating.

Table 2. Relative flowering season (adapted from Lateur and Populer, 1996)

State	Flowering period	Example of reference cultivars
1	Extremely early	
2	Very early	Beurré Alexandre Lucas, Comtesse de Paris, Kontoula, Kristalli
3	Early	Louise Bonne d'Avranches, Précoce de Trévoux, Passe Crassane, Blanquilla
4	Early/medium	Beurré de Mérode, Durondeau
5	Medium	Packhams's Triumph, Williams' Bon Chrétien (syn. Bartlett), Conference, Beurré Hardy
6	Medium/late	Triomphe de Vienne
7	Late	Doyenné du Comice, Jeanne d'Arc
8	Very late	Frangipane
9	Extremely late	

1.2 Regularity of flowering (*Priority 3*)

Following the assessment of flowering intensity over four to six representative years, accessions can be placed in categories of flowering regularity. Thinning methods must not be in place as these will act to mitigate this characteristic.

Table 3. Relative regularity of flowering (adapted from IBPGR, 1983)

State	Regularity of flowering	Example of reference cultivars
1	Very often irregular/Biennial	Gieser Wilderman
2	Intermediate behaviour	Louise Bonne d'Avranches, Nec Plus Meuris (syn. Beurré d'Anjou, Anjou Pear)
3	Very often regular	Conference, Williams' Bon Chrétien, Kristalli

1.3 Occurrence of secondary flowering during summertime (*Priority 2*)

Secondary flowering should initially be assessed in terms of intensity as per **Table 4**. Following at least five to six seasons, accessions can be then classified into different levels of frequency of secondary flowering (**Table 5**).

Table 4. Intensity of secondary flowering

The assessment is done several weeks after the end of flowering (petal fall).

State	Secondary flowering intensity	Field observations
1	Low	Absence of any secondary flowering
2	Medium	Flower clusters represent up to 5% of all buds
3	High	Flower clusters represent more than 5% of all buds

Table 5. Frequency of secondary flowering (IBPGR, 1983)

State	Frequency of secondary flowering	Reference cultivars
1	Rare	Beurré Hardy, Conference, Doyenné du Comice
2	Intermediate	Williams' Bon Chrétien
3	Frequent	Durondeau, Triomphe de Vienne, Clapp's Favourite, Passe Crassane, Général Leclerc, Abbé Fetel

2. Fruit

A sample of at least 6 to 12 representative fruits should be evaluated. Having identified the most representative fruits on the tree, the same protocol should be used for each accession, e.g. fruits taken from the sunny side at ¾ of the height of the trees. It is important to avoid the terminal (king) fruits. In general, it is recommended to perform fruit assessments in the orchard, in front of the tree where possible.

As per the CPVO Protocol (2006), it is recommended that all descriptions should be carried out at an optimal stage of ripening for fresh consumption. Unfortunately, there are no simple criteria to define an accession's good state of ripening, and this will remain a subjective judgement based on the expertise of the curators; frequent observation of the trees is recommended. Some factors offer useful indication, e.g. first preharvest drop of healthy fruit, change in ground and overcolour of the fruit, and taste of the fruit (acidity, starchiness, sugar level, firmness) but it is noted that these are themselves characterization/evaluation characters. Iodine starch index can also be a good indicator, but this is not always the case. It is generally recommended to not pick the fruit before reaching the 6-7 starch index score (Vaysse, Landry, 2004). For many cultivars, it may be necessary to either analyze samples of fruit picked as late as possible or after a period of postharvest ripening.

Since ripening time is difficult to accurately predict, and it is often not practical to finely monitor each individual accession, it is recommended as a method that the level of maturity at the date of picking and tasting is noted against the scale in **Table 6**. Scores of 1 or 5 should be taken to indicate that fruits are not suitable for a true assessment.

Table 6. Note provided after the estimation of the ripening stage of fruits when picked and/or tasted

State	Optimal ripening stage assessment
1	Much before optimal ripening stage
2	Just before optimal ripening stage
3	Optimal ripening stage
4	Just after optimal ripening stage
5	Much after the optimal ripening stage

2.1 Time of fruit ripening for eating (harvest maturity) (*Priority 1*)

It is recommended that the optimal date of picking be recorded during at least four to six representative seasons. Recording notes on the ripening stage (**Table 6**) should make it possible to estimate the average optimal ripening period and classify accessions in their relative maturity in comparison with reference cultivars as per **Table 7**.

It is noted that the range below may not be wide enough to represent the full range of ripening times across Europe and this descriptor should be optimized further accordingly in the future.

Table 7. Relative harvest maturity

State	Harvest maturity	Reference cultivars (IBPGR)	**Approximate and indicative periods of picking** (for north-western Europe)
1	Extremely early	Doyenné d'Eté (syn. Doyenné de Juillet), Kontoula	July–early August
2	Very early	Précoce de Trévoux, Beurré Giffard, Kristalli	Early August
3	Early	Clapp's Favourite	Mid-August
4	Early/Medium	Williams' Bon Chrétien, Beurré Superfin, Beurré de Mérode	Mid-August–Early September
5	Medium	Conference, Beurré Lebrun, Beurré Hardy	Mid-September
6	Medium/Late	Louise Bonne d'Avranches	End September–early October
7	Late	Nec Plus Meuris, Doyenné du Comice	Early October
8	Very late	Comtesse de Paris	Mid-October
9	Extremely late	Passe Crassane, Beurré d'Hardenpont (syn. Glou Morceau)	End October–November

2.2 Tendency to drop fruit at harvest time (*Priority 3*)

Assessment should be specific to healthy fruits (i.e. avoiding those that drop due to damage or factors other than ripening) and should be carried out at the judged time of optimal harvest as above.

Table 8. Tendency to drop fruit at harvest.

State	Drop observed	Proportion of fruit drop at harvest (%)
1	No drop observed	0
2	Very low drop	1–10
3	Low	11–25
4	Low to medium	X
5	Medium	± 50
6	Medium to high	X
7	High	± 75
8	High to very high	X
9	Very high	> 90

'X': Intermediate rating.

2.3 Precocity of fruit bearing (*Priority 2*)

Precocious trees of a given cultivar are defined as the ones that start to crop at an early age relative to other cultivars in a comparable situation. Assessment should be carried out on the same rootstock, place, type of tree and year of planting. The age of tree at planting, rootstock and other relevant factors should be noted for wider comparison.

Table 9. Relative precocity of fruit bearing

State	Precocity of fruit bearing	Example of reference cultivars
1	Extremely low	Doyenne du Comice, Magness
2	Low	Williams' Bon Chrétien
3	Intermediate	Beth, Devoe
4	High	Delbias, Kieffer
5	Extremely high	*P. calleryana*

2.4 Productivity (*Priority 2*)

Productivity can be assessed as the relative yield per tree. It is recommended that the assessment be carried out over a minimum of four to six years before an average score can be allocated as per **Table 10**.

Table 10. Productivity (adapted from IBPGR, 1983)

State	Productivity	Example of reference cultivars
1	Extremely low	Magness
2	X	
3	Low	Doyenne du Comice, Nec Plus Meuris
4	X	
5	Medium	Beurré Superfin, Williams' Bon Chrétien
6	X	
7	High	Beurré Alexandre Lucas, Kristalli
8	X	Conference
9	Extremely high	

'X': Intermediate rating.

2.5 Fruit shape (*Priority 1)*

It is recommended assessing fruit shape in three components as per **Figure 2**. Initially, the profile of the bottom (stalk end) of the fruit should be judged according to **Table 11**, then the relative position of the fruit's maximal diameter should be judged according to **Table 12,** and finally the ratio of fruit length to maximal diameter should be calculated and scored as per **Table 13**.

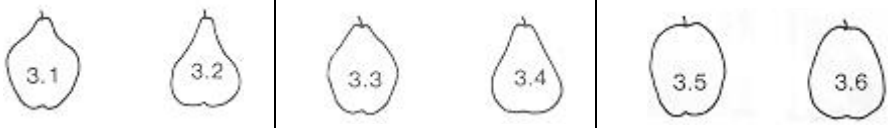
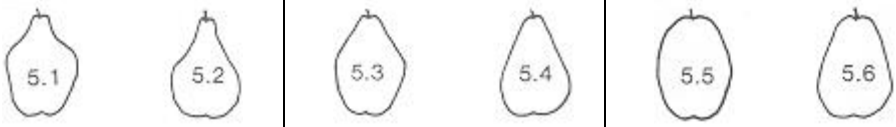
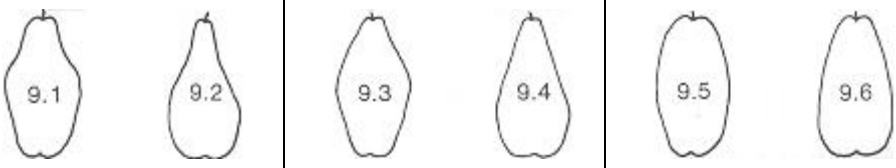
Ratio Fruit length/ max. diameter	Relative position of the maximum diameter					
	Towards the middle	Towards the eye	Towards the middle	Towards the eye	Towards the middle	Towards the eye
Very short < 1.1						
Short 1.1–1.25						
Intermediate 1.26–1.50						
Elongate 1.51–1.80						
Very elongate > 1.80						
Profile (stalk end)	**Concave**		**Straight**		**Convex**	

Figure 2. Global fruit shape – Shape/length relative to the maximum diameter, profile and position of the maximum diameter. (Modified from IBPGR, 1983) (***Priority 1***)

Table 11. Profile of bottom (stalk end) of fruit

State	Profile
1	Concave
2	Straight
3	Convex

1 = Concave 2 = Straight 3 = Convex

Figure 3. Profile of bottom (stalk end) of fruit

Table 12. Relative position of maximal diameter

State	Position
1	Towards the middle
2	Towards the eye

Table 13. Ratio of fruit length to maximum diameter

State	Ratio
1	< 1.1
2	1.1–1.25
3	1.26–1.50
4	1.51–1.80
5	> 1.80

2.6 Regularity of shape in profile (*Priority 3*)

Table 14. Fruit shape variability

State	Fruit shape variability	Reference cultivars
1	Regular shape	Nec Plus Meuris
2	Slightly variable shape	Doyenné du Comice
3	Highly variable shape	Conference (due to parthenocarpy)

2.7 Regularity of the symmetry of the fruit (*Priority 3*)

Table 15. Fruit symmetry variability

State	Fruit symmetry variability	Reference cultivars (CPVO)
1	Regularly symmetric	Passe Crassane
2	Slightly asymmetric	Beurré Bosc
3	Highly asymmetric	Beurré Clairgeau, Nouveau Poiteau

2.8 Fruit size (*Priority 1*)

At least 12 representative fruits should be evaluated over a minimum of four to six years. An average and relative score can then be assigned according to **Table 16**. It should be noted that these indicative values will differ across locations and growing systems.

Table 16. Fruit size

State	Fruit size	**Example of reference cultivars** (CPVO, IBPGR & Lateur)
1	Extremely small	
2	Very small	Petit Muscat, Doyenné d'Eté
3	Small	Doyenné de Juillet, Moscatellina
4	Small to medium	Beurré Giffard, Tyson, Beurré Superfin
5	Medium	Dr Jules Guyot, Epine du Mas, Clapp's Favourite, Beth, Nec Plus Meuris
6	Medium to large	Conference, Williams' Bon Chrétien
7	Large	Doyenné du Comice, Passe Crassane, Merton Pride
8	Very large	Marguerite Marillat, Pitmaston's Duchess
9	Extremely large	

2.9 Depth of fruit stalk cavity (*Priority 1*)

Crowning should be scored relative to the images in **Figure 4** and classifications in **Table 17**.

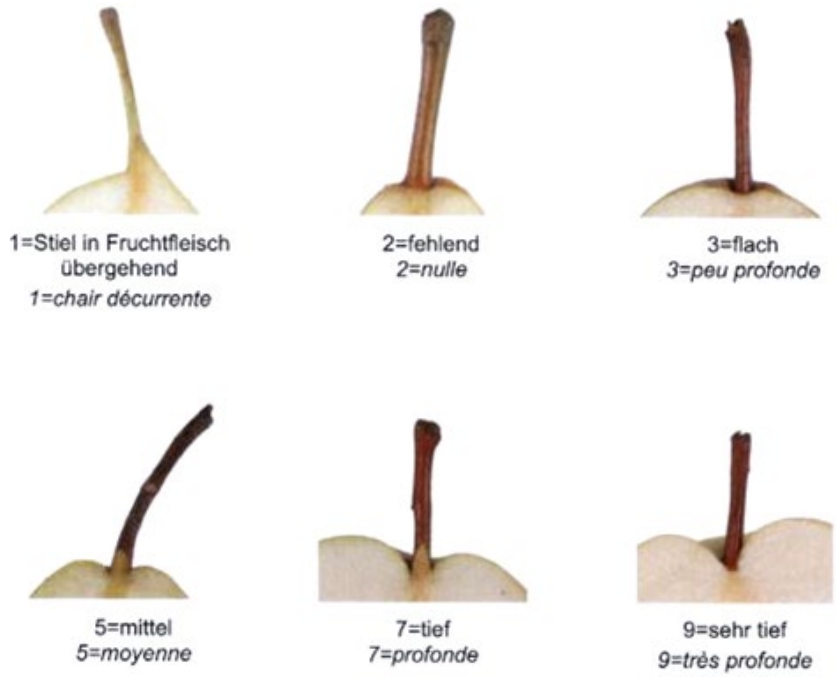


Figure 4. Illustration of stalk cavity depth (reproduced from Szalatnay, 2006).

Table 17. Depth of fruit stalk cavity

State	Cavity	Reference cultivars
1	Stalk in continuity with the fruit flesh	Beurré de Naghin, Madame Favre, Kontoula
2	Absent	Conference, Kristalli
3	Very shallow	Joséphine de Malines
4	Shallow	Doyenné du Comice, Louise Bonne d'Avranches
5	Medium	Précoce de Trévoux
6	X	-
7	Deep	Passe Crassane, Doyenné d'Hiver
8	X	Olivier de Serre
9	Very deep	-

'X': Intermediate rating

2.10 Thickness of fruit stalk (*Priority 3*)

Table 18. Average thickness of the stalk (Szalatnay, 2006)

State	Average thickness	**Example of reference cultivars** (CPVO, Szalatnay)
1	Thin (< 2mm)	Concorde, Beurré Bosc
2	Medium (2–3mm)	Beurré de Trévoux, Beurré Hardy
3	Thick (> 3mm)	Nec Plus Meuris, Clapp's Favourite

2.11 Attitude of stalk insertion in relation to axis of fruit (*Priority 3*)

Table 19. Average insertion of stalk in relation to fruit axis (CPVO)

State	Insertion of stalk	Example of reference cultivars
1	Straight	Doyenné de Juillet
2	Between 10° and 45°	Doyenné du Comice, Beurré Clairgeau
3	> 45°	Abbé Fétel, Marguerite Marillat

2.12 Colour of fruit skin ground (if visible) (*Priority 1*)

It is recommended, when possible, to control the judgement of colour against a standard colour chart such as the Royal Horticultural Society Colour Chart and reference to this is either included or needs to be in due course in line with UPOV (2019).

Ground colour could be scored relative to the images in **Figure 5** and classifications in **Table 20**. State 6 Orange is included as per Szalatnay (2006) and should be really considered based on use as a descriptor of ground colour.

Figure 5. Illustration of fruit skin ground colours (Szalatnay, 2006)

Table 20. Ground colour

State	Ground colour	**Example reference cultivars** (IBPGR, CPVO)
1	Yellow	Passé Crassane, Williams' Bon Chrétien
2	Whitish yellow	
3	Green yellow	Conference, Beurré Hardy, Beurré Giffard, Kristalli
4	Whitish green	
5	Green	Nec Plus Meuris, Nouveau Poiteau
6	(Yellow) – Orange	

2.13 Average amount of overcolour on fruit skin (*Priority 1*)

Table 21. Overcolour coverage

State	Overcolour coverage	Estimated percentage of coverage (%)	Example reference cultivars (e.g. CPVO)
1	Absent	0	Grand Champion, Passe Crassane, Beurré Lebrun, Conference
2	Very low	0–1	
3	Low	1–5	
4	Low to medium	X	Précoce de Trévoux
5	Medium	20–30	Louise Bonne d'Avranches
6	Medium to high	X	Herbst Forelle
7	High	± 50	Beurré Clairgeau
8	High to very high	X	
9	Very high	> 90	Red Bartlett, Red Anjou, Starkrimson

'X': Intermediate rating

2.14 Overcolour of the fully mature fruit skin (*Priority 1)*

Again, it is recommended when possible, to control the judgement of colour against a standard colour chart such as the Royal Horticultural Society Colour Chart and reference to this is either included or need to be in due course in line with UPOV (2019).

Overcolour could be scored relative to the images in **Figure 6** and classifications in **Table 19**.

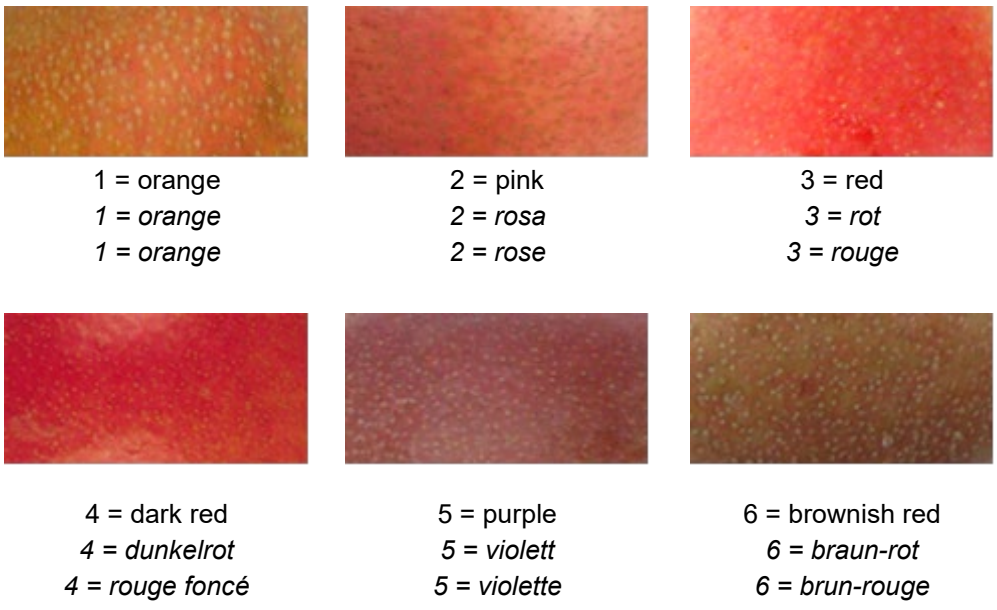


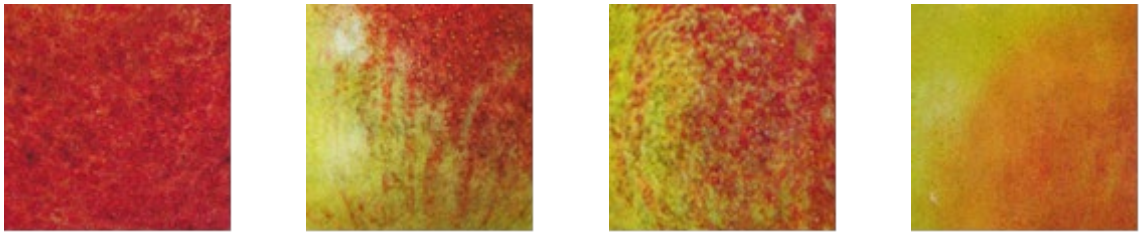
Figure 6. Illustration of skin overcolours (adapted from Szalatnay, 2006)

Table 22. Overcolour

State	Overcolour	Reference cultivars (e.g. UPOV)
0	Absent	
1	Orange	Précoce de Trévoux
2	Pink/(red)	Belle Angevine
3	Red	Herbst Forelle
4	Dark red	Starkrimson
5	Purple	Red Anjou
6	Brownish red	

2.15 Pattern of overcolour on fruit skin (*Priority 3*)

Pattern of overcolour should be scored relative to the images in **Figure 7** and classifications in **Table 23**.



1 = Solid flush 2 = Striped 3 = Mottled 4 = Washed out

Figure 7. Fruit skin overcolour patterns (adapted from Szalatnay, 2006)

Table 23. Overcolour pattern (adapted from Szalatnay, 2006)

State	Overcolour pattern	Example of reference cultivars (CPVO-UPOV 2003)
1	Only solid flush	Hortensia
2	Only striped	Précoce de Trévoux
3	Mainly mottled	Louise Bonne d'Avranches, Herbst Forelle
4	Washed out (faded)	Beurré Giffard

2.16 Overall amount of russet on fruit skin (*Priority 1*)

For fruit russet coverage, at least 6–12 representative fruits should be evaluated. An average score for overall coverage is recorded at harvest, at full fruit ripeness (**Table 24**).

Table 24. Overall russet coverage

State	Russet coverage	Estimated percentage of coverage (%)	Examples of reference cultivars (partially CPVO, IBPGR & Petzold)
1	Absent	0	Grand Champion, Clapp's Favourite, Kontoula
2	Very low	0–1	Beurré Lebrun, Kristalli
3	Low	1–5	Beurré d'Hardenpont, Packam's Triumph
4	Low to medium	X	William's Bon Chrétien
5	Medium	20–30	
6	Medium to high	X	Comtesse de Paris, (Conference)
7	High	± 50	Jeanne d'Arc, (Conference)
8	High to very high	X (± 75)	Beurré Hardy, Callebasse Bosc
9	Very high	> 90	Madame Verte

'X': Intermediate rating

2.17 Russet area around stalk cavity (adapted from Szalatnay, 2006) (*Priority 3*)

Table 25. Russet around stalk cavity

State	Russet coverage	Estimated percentage of coverage (%)
1	Absent	0
2	Very low	x
3	Low	± 25
4	Low to medium	x
5	Medium	± 50
6	Medium to high	x
7	High	± 75
8	High to very high	x
9	Very high	> 90

'X': Intermediate rating

2.18 Russet area around eye basin (adapted from Szalatnay, 2006) (*Priority 3*)

Table 26. Russet around eye basin

State	Russet coverage	Estimated percentage of coverage (%)
1	Absent	0
2	Very low	x
3	Low	± 25
4	Low to medium	x
5	Medium	± 50
6	Medium to high	x
7	High	± 75
8	High to very high	x
9	Very high	> 90

'X': Intermediate rating

2.19 Aperture of eye (*Priority 3*)

For aperture of eye, at least 6–12 representative fruits should be evaluated (**Table 27**) at full fruit ripeness.

Table 27. Aperture of eye

State	Aperture of eye	Examples of reference cultivars (Petzold)
1	Closed	Le Lectier, Beurré Alexandre Lucas
2	Partly open	Beurré Diel, Beurré d'Hardenpont, Conference
3	Fully open	Comtesse de Paris, Durondeau, Beurré Hardy

2.20 Insertion of eye sepals at harvest (*Priority 3*)

At least 6–12 representative fruits should be evaluated (**Table 28**) at full fruit ripeness

Table 28. Insertion of sepals at their base

State	Insertion of sepals	**Examples of reference cultivars** (Petzold)
1	Fully welded sepals forming a visible ring like a crown	Josephine de Malines, Beurré Alexandre Lucas, Clapp's Favourite, Comtesse de Paris
2	Half-welded – half-free sepals	Williams' Bon Chrétien, Conference
3	Fully free sepals	Beurré Diel

2.21 Length of stalk (*Priority 3*)

Length of stalk is a variable character and representative sampling is important – at least 12 representative fruits should be evaluated at harvest (**Table 29**).

Table 29. Stalk length (adapted from Szalatnay, 2006)

State	Stalk length	Average length (mm)	**Example of reference cultivars** (Petzold, CPVO)
1	Very short	< 15	Nec Plus Meuris
2	Short	15–24	Beurré Clairgeau
3	Medium	25–34	Comtesse de Paris, Beurré Hardy, Beurré d'Hardenpont, Beurré Alexandre Lucas, Doyenné du Comice
4	Long	35–44	Beurré Six, Triomphe de Vienne, Légipont, Conference
5	Very long	≥ 45	Ulmer Butterbirne, Curé, Beurré Bosc

2.22 Flesh colour (*Priority 3*)

Table 30. Flesh colour at full maturity (transversal cut)

State	Flesh colour	Example of reference cultivars
1	White	Comtesse de Paris
2	Greenish white	
3	Yellowish white	
4	Yellowish	
5	Pinkish red	Sanguinole

2.23 Number of seeds (*Priority 1*)

An average of fully formed seeds from approximately 12–20 fruits should be calculated. An average lower than 3–4 indicates that a cultivar is likely triploid and a complete lack of seeds can be taken as an indicator of parthenocarpy (Lateur, 1996). Note that this characteristic can be highly influenced by environmental conditions and pollen availability.

Table 31. Number of seeds

State	Average number of well-formed seeds	Example of reference cultivars
1	0	
2	1–3	Beurré Alexandre Lucas
3	4–5	
4	6–10	
5	11–15	
6	> 15	

2.24 **Photographs of picked fruit samples** (adapted from Szalatnay, 2006) (***Priority 1***)

It is important that samples are representative and very young. Old, high- and low-yielding trees should be avoided, along with seasons with uncharacteristic conditions. Labels should include, as a minimum: accession name, accession number, tree position and date. Photographs may be taken under natural light (avoiding early morning or late afternoon) or artificial light (including flashlight in studio conditions). A standard size reference (ideally grid) should be included as well as a minimum set of views (as shown in **Figure 8**). All accessions for entry into ECPGR databases should have photographs available.

Further advisory details on photography can be found in **Annex 1**.

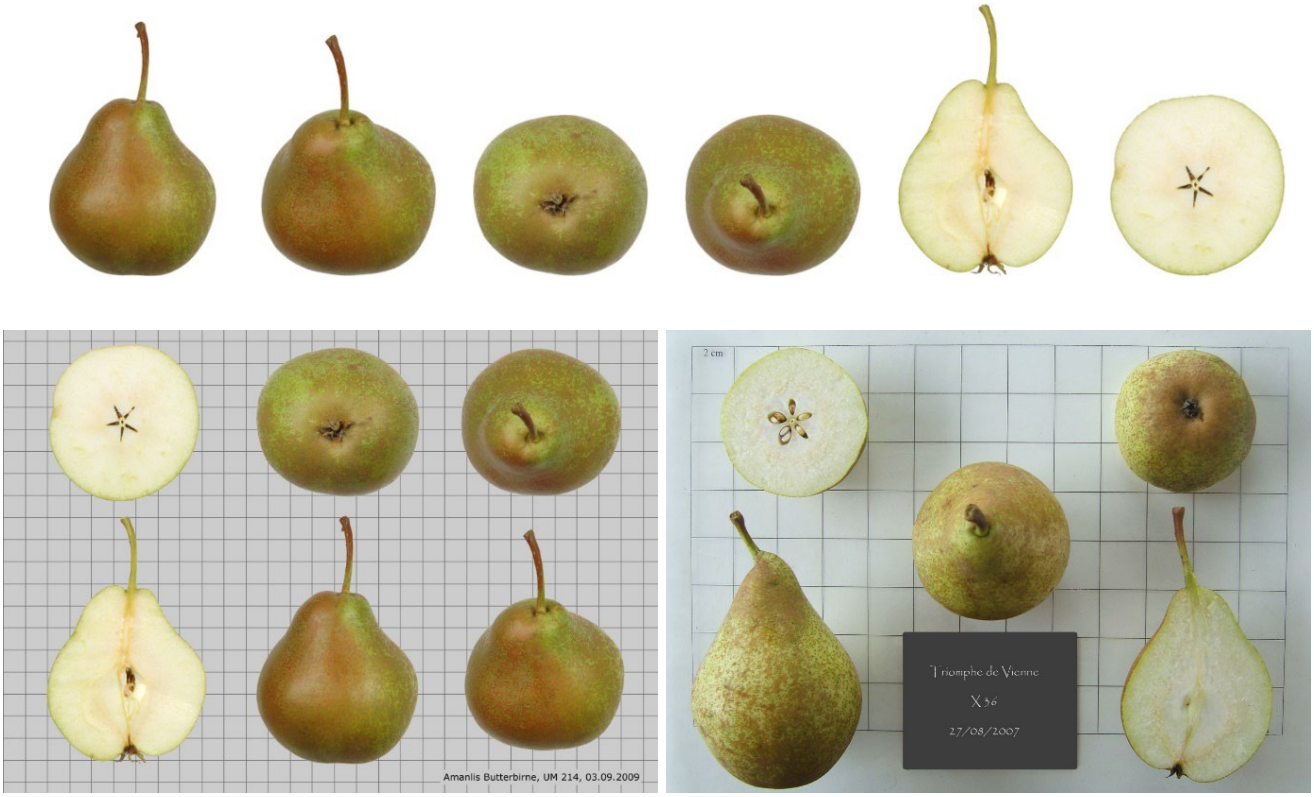


Figure 8 – Examples of illustrations of fruit pictures. (Pictures: Top and bottom left, Szalatnay (2016); bottom right, CRA-W)

2.25 Photographs of fruit hanging on the tree (*Priority 1*)

A representative fruit, or group of fruits well placed on the tree, should be selected. It is often practical to take a picture firstly of the tree label and/or the name on a list in order to trace the name of the accession. When possible, it is very important to get a clear view of the fruit eye (**Figure 9**). It is recommended to use a white panel as a natural light reflector as this can improve the precision of the fruit image.

Figure 9. Examples of pear fruit cultivars photographed on the tree (CRA-W)

3. Tree

3.1 Tree global architecture (*Priority 2*)

Tree architecture should be characterized when trees are at least 10 years old and should be scored using the IBPGR and CPVO classifications (**Table 32** and **Figure 10**).

Table 32. Tree architecture

State	Tree form	Example of reference cultivars
1	Very upright or 'Fastigiate'	Jeanne d'Arc, Président Héron, Général Leclerc
2	X	November Birne (syn. Nojabrskaja), Colorée de Juillet
3	Upright	Beurré Clairgeau, Doyenné du Comice, William Bon Chretien, Kristalli
4	X	Conference
5	Spreading	Madame Baltet
6	X	
7	Drooping	Beurré Alexandre Lucas, Clapp's Favourite; Beurré Diel, Beurré Six
8	X	
9	Weeping	Beurré d'Amanlis

'X': Intermediate rating

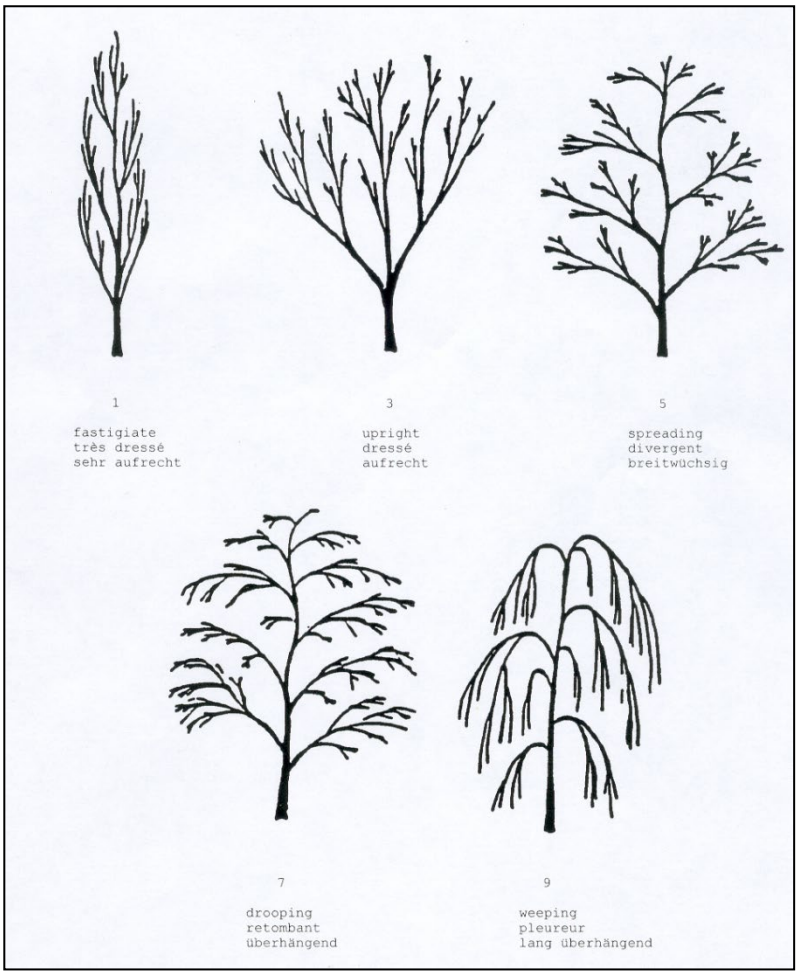


Figure 10. Global tree shape (CPVO, 2003).

3.2 Affinity or compatibility with Quince (*Priority 3*)

Degrees of incompatibility may differ between quince rootstocks, and it is necessary to record the specific stock in use. It is also possible to observe incompatibility in both the nursery and in trees planted out in the orchard. Therefore, the age of trees should also be noted (**Table 33**).

Table 33. Affinity with Quince

State	Affinity	Example of reference cultivars
1	Extremely poor	Beurré Chaboceau
2	Very poor	Clapp's Favourite, Gieser Wilderman, Beurré Bosc, Triomphe de Vienne
3	Poor	Dr Jules Guyot, St Rémy, Epine du Mas, Beurré Alexandre Lucas
4	Poor to intermediate	
5	Intermediate	Louise Bonne d'Avranches, Précoce de Trévoux, Williams' Bon Chrétien
6	Intermediate to good	
7	Good	Général Leclerc
8	X	Curé
9	Extremely good	Passe Crassane, Beurré Hardy, Doyenné du Comice

'X': Intermediate rating

4. Pest and disease susceptibility

For pest and disease susceptibility assessment, it is particularly important to note details of the management scheme for fungicide and/or insecticide application during at least five years preceding the first evaluation. It is strongly recommended to not spray evaluation orchards for several seasons before the evaluation process (at least five years would be ideal).

It is also important to carefully check that the pest/disease is homogeneously distributed inside the plot, and useful to plant sufficient susceptible control cultivars throughout the field to help identify the occurrence of localized infections.

The most widely used assessment keys are based on a global approach for the assessment of the intensity of the pest/disease. Intensity is the sum of two components: *incidence* and *severity*. *Incidence* is the qualitative 'presence' and 'absence' of symptoms (generally defined by the proportion of organs affected by at least one symptom); *severity* is the quantitative proportion of a surface, length or volume of an organ that is infected by the disease. In some instances, when more precision is needed on the type of resistance, it can be valuable to evaluate the two components of disease, *incidence* and *severity*, independently.

4.1 Scab (*Venturia pyrina*) (*Priority 2*)

Photo 1. Scab primary infection symptoms on young pear fruit during springtime (CRA-W).

At least one observation should be made per year: at the end of the growing season for fruit scab. If possible, though, it is recommended to assess leaf scab at least two times in the season in order to be able to evaluate the primary (**Photo 1**) and secondary infections. Pear scab symptoms on leaves are mostly developed on the back of the leaf (**Photos 2 and 3**) and are more difficult to detect during the second half of the growing season. Therefore, it is recommended to assess leave scab susceptibility in June. It is much easier to make the assessment when leaves are dry. Assessment on shoots (**Photo 4**) should be made just after leaves are fallen and on shoots that are 1–3 years old.

The most common and easiest way for assessing the intensity of symptoms on leaves, fruits and twigs is based on the use of **global assessment** scales that take into account and integrate into one global score, the incidence and severity status (**Tables 34, 35** and **36**).

'*Incidence*' is defined as the estimated percentage of infected organs (leaves or fruits) that express at least one clear and visible symptom of the disease. '*Severity*' refers to the estimated mean area of the infected organs covered by clear symptoms.

Table 34. Global Assessment scale for scab infection on **leaves** (adapted from Lateur and Populer, 1996)

State	Field observations	Visual rating estimation	
		Incidence (%)	Severity (%)
1	No visible symptom	0	-
2	A few small scab spots are detectable on close scrutiny of the tree	≤ 1	-
3	Scab immediately apparent, with lesions very thinly scattered over the tree	> 1–5	-
4	X	X	-
5	Infection widespread over the tree, majority of leaves with at least one lesion	≥ 50	≤ 5
6	X	≥ 50	X
7	Heavy infection; multiple lesions or larger surfaces covered by scab on most leaves	≥ 50	± 25
8	X	≥ 50	X
9	Maximum infection; leaves black with scab and most of them are falling.	≥ 50	> 75

'X': Intermediate rating

Photos 2 and 3. Scab symptoms on the lower side of a young pear tree during springtime (CRA-W).

Table 35. Global assessment scale for scab infection on **fruits** (adapted from Lateur and Populer, 1996)

State	Field observations	Visual rating estimation	
		Incidence (%)	Severity (%)
1	No visible symptom	0	-
2	A few small scab spots are detectable on close scrutiny of the tree	≤ 1	-
3	Scab immediately apparent, with lesions on fruits very thinly scattered over the tree	≤ 5	-
4	X	X	-
5	Infection widespread over the tree, majority of fruits with at least one lesion	≥ 50	≤ 5
6	X	≥ 50	X
7	Heavy infection; multiple lesions or more large surfaces covered by scab on most fruits, some fruits with skin cracks in scabbed lesions	≥ 50	± 25
8	X	≥ 50	X
9	Maximum infection; fruits black with scab; most of them are dropping and/or infected by *Monilinia* sp.	≥ 50	> 75

'X': Intermediate rating

Table 36. Global assessment scale for scab infection on **twigs** (adapted from Lateur and Populer, 1996)

State	Field observations	Visual rating estimation	
		Incidence (%)	Severity (%)
1	No visible symptom	0	-
2	A few small scab symptoms are detectable on close scrutiny of the branches	≤ 1	-
3	Scab symptoms immediately apparent, with lesions scattered over the tree	≤ 5	5–10
4	X	X	-
5	Infection widespread over the branches, majority of fruits with at least one lesion; some large surfaces covered by scab – 5 to 10cm long – extremity of twigs with few leaves, but no dead twigs	≥ 50	± 25
6	X	≥ 50	X
7	Heavy infection; multiple lesions on the longest part of twigs and more large surfaces covered by scab on most branches, portion of young twigs extremities are dead	≥ 50	± 50
8	X	≥ 50	± 75
9	Maximum infection; mostly all young twigs are killed by scab necrosis.	≥ 50	> 90

'X': Intermediate rating

Photo 4. Scab infection symptoms on young twig (CRA-W).

Alternatively, and at a lower priority level, when a more precise approach is justified, it could be recommended to separate the assessment of the two complementary components of disease intensity by making an assessment for incidence and another for severity.

The key for incidence assessment is given in **Table 37** and the key for severity assessment is given in **Table 38**.

Table 37. Incidence assessment key for pear scab – wither on leaves, fruits or twigs **(*Priority 4*).**

State	**Mean visual estimated proportion of infected parts (leaves, fruits or twigs)** (%)
1	0
2	]0–1]
3	]1–5]
4	X
5	± 25
6	X
7	± 50
8	X
9	> 90

'X': Intermediate rating

Table 38 & Figure 11. Severity assessment key for pear scab – Either on leaves, fruits or twigs – ***(Priority 4).***

State	Mean visual estimated proportion of scab-infected surface (leaves, fruits or twigs) (%)
1	0
2	]0–1]
3	]1–5]
4	X
5	± 25
6	X
7	± 50
8	X
9	> 90

'X': Intermediate rating

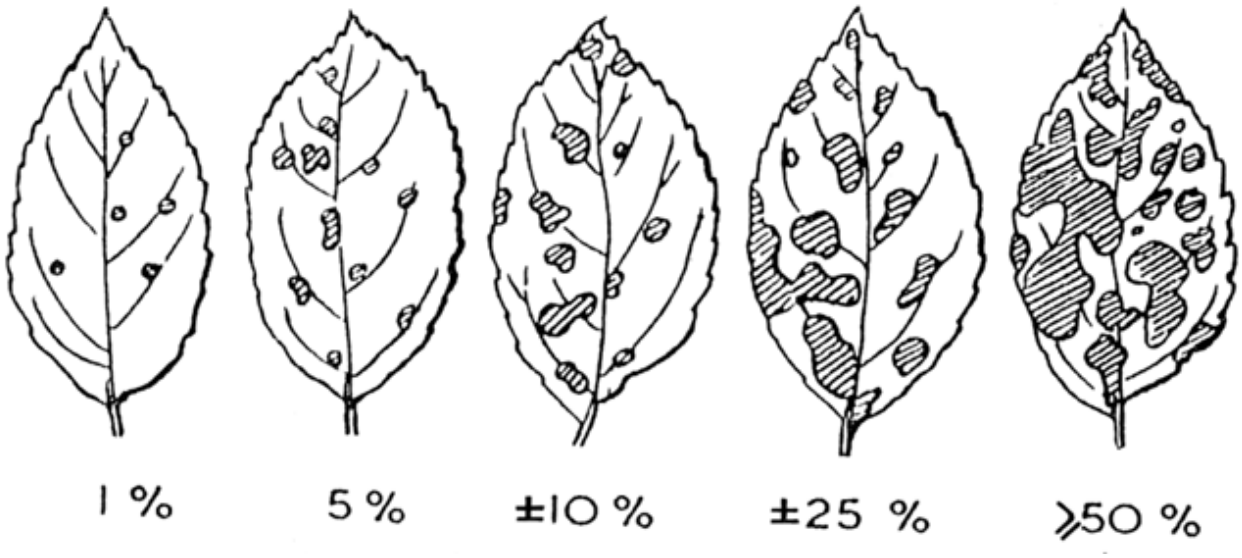


Figure 11. Assessment of scab severity on leaves (reproduced from Croxall *et al.,* 1952)

4.2 Pear rust (*Gymnosporangium sabinae*) (*Priority 2*)

Assessment should be done in the evaluation orchard at the end of summertime.

Table 39. Pear rust global infection assessment scale on leaves

State	Field observations	Visual rating estimation	
		Incidence (%)	Severity (%)
1	No visible symptom	0	-
2	A few small rust spots are detectable on close scrutiny of the tree	≤ 1	-
3	Rust spots immediately apparent, with lesions very thinly scattered over the tree	≤ 5	-
4	X	X	-
5	Infection widespread over the tree, majority of leaves with at least one rust spot	≥ 50	≤ 5
6	X	≥ 50	X
7	Heavy infection; several rust spots covered on most leaves	≥ 50	± 25
8	X	≥ 50	X
9	Maximum infection	≥ 50	> 75

'X': Intermediate rating

4.3 *Neonectria* canker (*Neonectria ditissima*) (*Priority 3*)

Neonectria ditissima is very often a much less important disease for pear tree cultivars than for apples. Accurate evaluation needs to consider the distribution of the disease across the orchard; it is normally achieved when more than 50% of the trees are at least moderately infected. **Table 40** shows an assessment scale.

Table 40. Infection assessment scale of *Neonectria* canker on branches (Lateur, 1999)

State	Observation in the orchard	Visual rating estimation Incidence – Proportion of twigs and branches infected (%)
1	No visible canker symptom	0
2	One or very few small cankers, detectable only on close scrutiny of the tree	0–1
3	Directly apparent cankers without important consequences for the tree	1–5
4	X	X
5	Cankers widespread over the branches, inducing the death or the ablation of a large part of the crown	± 25
6	X	X
7	Heavy infection; about half of the crown is badly affected with risk of ablation or death	± 50
8	X	X
9	Maximum infection, tree completely affected, nearly dead	> 90

'X': Intermediate rating

4.4 Fire blight (*Erwinia amylovora*) (*Priority 2*)

Even if the EU recently (2020) classified it as a "regulated non-quarantine pests" organism (Commission Implementing Directive (EU) 2020/177), fire blight (*Erwinia amylovora)* is still a major threat to pear orchards and can have a major impact in the safe management of repository and evaluation orchards. Monitoring of the disease is needed in terms of prophylactic measures, and needs to start during the flowering period.

An assessment scale is shown in **Table 41**.

Table 41. Infection assessment scale to fire blight on branches (Lateur, 1999)

State	Observation in the orchard	Visual rating estimation Incidence (%)
1	No visible symptom	0
2	One or very few small infections, detectable only on close scrutiny of the tree	0–1
3	Directly apparent infections without important consequences for the tree	1–5
4	X	X
5	Disease widespread over the branches, inducing the death or the ablation of a large part of the crown	± 25
6	X	X
7	Heavy infection; about half of the crown is badly affected with risk of ablation or death	± 50
8	X	X
9	Maximum infection, tree completely affected, nearly dead	> 90

'X': Intermediate rating.

4.5 Fruit brown rot (*Monilinia fructigena*) (*Priority 2*)

Table 42. Fruit brown rot assessment scale at harvest period.

State	Brown rot susceptibility	Incidence (Estimated % of infected fruits)
1	No symptom visible	0
2	Very low	0–1
3	Low	1–5
4	Low to medium	X
5	Medium	± 25
6	Medium to high	X
7	High	± 50
8	High to very high	± 75
9	Very high	> 90

'X': Intermediate rating.

4.6 Pear leaf blister mite (*Eriophyes pyri*) (*Priority 3*)

Symptoms should be evaluated during late spring (**Photo 4**).

Table 43. Assessment scale for infection by pear leaf blister mites

State	Field observations	Visual rating estimation	
		Incidence (%)	Severity (%)
1	No visible symptom	0	-
2	A few small spots are detectable on close scrutiny of the tree	≤ 1	-
3	Spots immediately apparent, with lesions very thinly scattered over the tree	≤ 5	-
4	X	X	-
5	Infection widespread over the tree, majority of leaves with at least one spot	≥ 50	≤ 5
6	X	≥ 50	X
7	Heavy infection; several spots covered on most leaves	≥ 50	± 25
8	X	≥ 50	X
9	Maximum infection	≥ 50	> 75

'X': Intermediate rating.

Photo 5 – Symptoms of pear leaf blister mite on young pear leaves during springtime (CRA-W)

NB: *Other pests or diseases susceptibility assessments (*e.g. Contarinia pirivora, Psylla piri, Mycosphaerella sentina*, etc.) may be developed following the same scoring principles.*

4.7 Global tree foliage health (*Priority 3*)

Assessment should be based on overall appearance, and will represent a combination of disease tolerance, robustness and good nutrients uptake efficiency indicated by healthy green leaves. (**Table 44**).

Table 44. Assessment scale for global tree foliage health

State	Appearance
1	Extremely low health foliage (> 90% of leaves suffering diverse heavy foliar deficiencies)
2	X
3	Low health foliage (± 75% of leaves suffering diverse heavy foliar deficiencies)
4	X
5	Medium health foliage (± 50% of leaves without foliar deficiency)
6	X
7	High health foliage (± 75% of leaves without foliar deficiency)
8	X
9	Extremely high health foliage (> 90% of leaves without any foliar deficiency)

'X': Intermediate rating

5. Fruit quality traits

As an initial evaluation procedure, sensory assessment is simple and efficient; it provides relative values that simulate the consumer habit, but it requires some experience. In principle, a first sensory analysis can be performed directly in the orchard in front of the tree.

When assessing fruit quality by sensorial approach, it is important to select a representative fruit sample and neutralize the influence of the sample previously tasted, since this could affect the assessment. The sensorial analysis should be ideally performed by two people and the fruit should be tasted without the skin.

Accurately predicting ripening times is difficult and it is recommended to note the actual level of maturity at the date of picking and tasting by using the scale in **Table 6**.

The use of instrumental measurements can be more precise but much more time-consuming, although recommendations for these are also provided. General rules and methods recommended for the instrumental fruit trait analysis are defined in the CTIFL reference publication (Vaysse and Landry, 2004).

In general, quality measures should be assessed at eating maturity and the sample of fruit should be taken from the upper part of the tree, on the sunny side.

Pears need to be picked at their correct maturity stage – for autumn and winter pears, this means well before their eating maturity – and have to be stored in a cool room, cellar or fridge for a number of days, weeks or even months before reaching their optimal ripeness. Some cultivars are not suitable for fresh consumption before having matured.

Periodically, fruits should be inspected and the change in ground colour can be used as an indication of their maturity stage. The greenish ground colour starting to turn yellow is a useful indication. This can be cultivar specific, and for some cultivars, the assessment must be carried out earlier; for others, it is necessary to wait until the ground colour becomes fully yellow. Nowadays, people like more and more to eat pears before they reach their typically smelting texture and this is another factor that complicates the evaluation process.

Ideally, each trait linked with fruit-eating quality needs to be assessed at the optimal fruit-ripening stage.

Many old pear cultivars were only used for baking in the oven or cooking in water or after other simple processing methods (canning, drying, cider, syrup, etc.). These specific quality traits are not taken into account in the present document.

5.1 Eating maturity (*Priority 1*)

As described above, fruit samples should be stored in air at optimal temperature and humidity for their ripening process. Each week, it is necessary to check their ripening process and taste samples that reach the right ripening stage – often when fruit ground colour is just turning from green to yellow green.

Table 45. Assessment scale for estimation of the optimal eating maturity period

State	Eating maturity – Optimal relative period for best eating quality	Example of reference cultivars (Petzold and IBPGR)
1	Extremely early	Doyenné d'Eté (syn. Doyenné de Juillet), Précoce de Morettini
2	Very early	Précoce de Trévoux, Beurré Giffard
3	Early	Clapp's Favourite
4	X	Williams' Bon Chrétien, Beurré Superfin
5	Medium	Conference, Beurré Lebrun, Beurré Hardy
6	X	Louise Bonne d'Avranches
7	Late	Doyenné du Comice
8	Very late	Nec Plus Meuris, Beurré d'Hardenpont (Syn. Glou Morceau), Joséphine de Malines
9	Extremely late	Passe Crassane, Comtesse de Paris

'X': Intermediate rating

5.2. Susceptibility to fruit flesh internal core breakdown (*Priority 2*)

During the post-harvest process of ripening, some cultivars are very susceptible to an internal brown softening from their core flesh. The assessment should be made at the time of optimal eating maturity and eventually, just after.

Table 46. Assessment scale for susceptibility to develop internal fruit flesh core breakdown (Lateur, 1999)

State	Level of susceptibility	Incidence (%)	Example reference cultivars
1	Extremely low	0	
2	Very low	0–1	Beurré d'Hardenpont
3	Low	1–5	
4	X	X	
5	Medium	± 25	
6	X	X	Conference
7	High	± 50	Blanquilla
8	X	X	Beurré Lebrun, Beurré de Mérode, Calebasse à la Reine
9	Extremely high	> 90	

'X': Intermediate rating

5.3 Fruit firmness (Priority 2/3)

5.3.1. Using a penetrometer (*Priority 3*)

Following the protocol described by Vayse and Landry (2004), the assessment should be performed at a minimum at picking time, on a sample of at least six fruits, making two opposite measurements situated at the widest part of the fruit. Measurements should be taken on both sides of the fruits (for bicoloured fruit at the borders between the overcoloured zone and ground colour).

Ideally, a series of measurements should be taken at picking time, the time of transition of ground colour from green to yellow, and at eating maturity (where these differ). In all cases, an 8mm (0.5cm^2) probe should be used and skin should be removed. The data are expressed as kg/cm^2.

5.3.2. Sensory analysis (*Priority 2*)

Firmness should be evaluated at optimal eating maturity by assessing the relative force needed for masticating a bit of fruit (**Table 47**).

Table 47. Sensory assessment scale of fruit firmness

State	Fruit firmness	**Example reference cultivars** (IBPGR et CPVO)
1	Extremely soft	Beurré Giffard, Doyenné du Comice
2	Very soft	
3	Soft	Jeanne d'Arc
4	X	
5	Intermediate	Beurré Hardy, Légipont (syn. Fondante de Charneux), Conference, Williams' Bon Chrétien
6	X	
7	Firm	Comtesse de Paris, Nec Plus Meuris
8	Very firm	
9	Extremely firm	

'X': Intermediate rating

5.4 Skin thickness (*Priority 3*)

Skin thickness should be scored by sensory assessment based on the resistance to masticating the skin (**Table 48**) at the full optimal maturity stage.

Table 48. Fruit skin thickness sensory assessment scale

State	Skin thickness	**Example reference cultivars** (UPOV, Szalatnay)
1	Extremely thin	
2	Very thin	Grand Champion, Williams' Bon Chrétien
3	Thin	Beurré Bosc
4	X	
5	Medium	Doyenné du Comice, Conference
6	X	Beurré Superfin
7	Thick	Curé, Comtesse de Paris, Jeanne d'Arc
8	Very thick	St Rémy
9	Extremely thick	

'X': Intermediate rating

5.5 Flesh sweetness (*Priority 2/3)*

5.5.1 Sensory analysis (*Priority 2*)

Flesh sweetness should be assessed at optimal eating maturity.

Table 49. Flesh sweetness sensory assessment scale

State	Sweetness
1	Extremely low
2	Very low
3	Low
4	X
5	Intermediate
6	X
7	High
8	Very high
9	Extremely high

'X': Intermediate rating

5.5.2 Refractometer method (*Priority 3*)

In a laboratory: this is done, at a minimum, at optimal picking time on a sample of at least six representative fruits and is expressed as ° Brix. Standard protocols extract the juice of the fruits from two slices/fruit – with a press or an extractor – and then make the measurement on the obtained juice with a refractometer at room temperature.

In the field: the simplest method consists of putting on the refractometer a mix of at least four droplets of juice extracted by pressure between thumbs and index of pieces of fruits from different representative fruits. Another way of extracting the droplets consists of driving a glass stick into the fruit at two opposite sites situated on the largest diameter of the fruit (for bicoloured fruit at the borders between the overcoloured zone and ground colour).

Scores should be expressed as ° Brix.

5.6 Flesh acidity

Flesh acidity should be assessed and/or measured at optimal eating maturity

5.6.1. Sensory analysis (*Priority 2*)

Table 50. Flesh acidity sensory assessment scale

State	Flesh acidity
1	Extremely low acidity
2	Very low acidity
3	Low acidity
4	X
5	Intermediate acidity
6	X
7	High acidity
8	Very high acidity
9	Extremely high acidity

'X': Intermediate rating.

5.6.2. Measurement with a pH meter (*Priority 3*)

Measurements should be taken on juice from a sample of at least six representative fruits using the same juice extraction techniques as for flesh sugar measurement.

5.6.3. Measurement by titration (*Priority 3*)

Standard methods (Vaysse and Landry, 2004) should be used, with titration using NaOH. Data should be expressed in g Malic acid/l.

5.7 Ratio between acidity and sweetness (*Priority 1*)

When tasting a sample of fruit at optimal ripening stage, a general impression of the balance between acidity and sweetness should be scored (**Table 51**).

Table 51. Ratio acidity/sweetness of flesh sensory assessment scale

State	Acidity/sweetness	Example of reference cultivars
1	Extremely more acid than sweet	
2	Much more acid than sweet	Durondeau, Curé
3	More acid than sweet	Beurré Superfin, Beurré de Mérode, Beurré Alexander Lucas, Précoce de Trévoux
4	X	Williams' Bon Chrétien, Louise Bonne d'Avranches
5	Good balance acid/sugar	Doyenné du Comice
6	X	
7	More sweet than acid	
8	Much more sweet than acid	Conference, Triomphe de Vienne
9	Extremely more sweet than acid	Seigneur Esperen

'X': Intermediate rating

5.8 Flesh juiciness (*Priority 2*)

Juiciness sensory evaluation is defined as the assessment of the quantity of juice extracted from a sample of fruit at optimal maturity stage when it is masticated (**Table 52**).

Table 52. Sensory assessment scale for flesh juiciness

State	Flesh juiciness	Example reference cultivars (CPVO)
1	Extremely low	
2	Very low	
3	Low	
4	X	
5	Intermediate	
6	X	Williams' Bon Chrétien, Kontoula
7	High	Conference, Grand Champion, Kristalli
8	Very high	Doyenné du Comice, Beurré Hardy
9	Extremely high	

'X': Intermediate rating

5.9 Flesh crunchiness (*Priority 2*)

Crunchiness should be assessed as the sustained granular resistance of flesh during mastication at optimal maturity stage. It can be distinguished from crispness, in that crispness is generally associated with brittleness and the shattering of food and is short-lived. Crunchiness can also be identified by the noise made during mastication (**Table 53**).

Table 53. Flesh crunchiness sensory assessment scale

State	Flesh crunchiness	Reference cultivars
1	Extremely low	
2	Very low	
3	Low	
4	X	
5	Intermediate	
6	High	
7	Very high	
8	X	
9	Extremely high	

'X': Intermediate rating

5.10 Astringency feeling of the fruits (*Priority 1*)

Some specific cultivars and/or unripe cultivars and/or old specific cooking cultivars express a quantitative sensory reaction of 'astringency' that can be described as a "variable intensity of drying and puckering feeling on your tongue and oral cavity caused by the presence of some polyphenols and tannins" (Jiang *et al*. 2014). In some old descriptions, the term "*vinous flavour*" is used for describing some level of astringency expressed by some cultivars.

Should be assessed sensorially based on **Table 54**.

Table 54. Assessment scale for astringency quantitative feeling of pear fresh flesh

State	Astringency	Example reference cultivars
1	Extremely low	
2	Very low	
3	Low	Durondeau
4	X	
5	Medium	
6	X	Pitmaston Duchess
7	High	
8	Very high	Saint-Remy
9	Extremely high	

'X': Intermediate rating

5.11 Intensity of musky taste/aroma (*Priority 1*)

In old literature, flesh quality descriptions used the terminology "musky taste" or "trace of muskiness" which defines a specific aroma of some well-known cultivars like Williams' Bon Chrétien, which illustrates this specific "pear aroma". Muskiness should be assessed as the intensity of this type of aroma at the point of optimal eating maturity (**Table 55**).

Table 55. Musky aroma intensity sensory assessment scale

State	Intensity	Example reference cultivars
1	Extremely low	Doyenné du Comice
2	Very low	
3	Low	
4	X	
5	Medium	Beurré Lebrun
6	X	
7	High	
8	Very high	Williams' Bon Chrétien
9	Extremely high	

'X': Intermediate rating

5.12 Fruit flesh texture (*Priority 1*)

The fineness or "buttery texture" or at the opposite, "coarseness" of flesh texture should be assessed sensorially and scored according to **Table 56**.

Table 56. Fruit flesh texture sensory assessment scale

State	Flesh texture	Example reference cultivars (CPVO, IBPGR)
1	Extremely fine	
2	Very Fine	Grand Champion, Doyenné du Comice, Beurré Giffard, Joséphine de Malines
3	Fine	Beurré Hardy, Conférence, Beurré Superfin, Williams' Bon Chrétien
4	X	Beurré Alexandre Lucas
5	Intermediate	Beurré Bosc, President Drouard, Nec Plus Meuris
6	X	Pitmaston Duchess (syn. Williams Duchess), Beurré Diel
7	Coarse	Précoce de Henin, Curé, Durondeau, Beurré Clairgeau
8	Very Coarse	
9	Extremely coarse	St Rémy

'X': Intermediate rating

5.13 Presence of grit cells in the flesh (*Priority 2*)

Some pear cultivars have typical grid cells of variable intensity and texture inside their flesh and especially around their central part.

Should be assessed sensorially on flesh and especially from close to the core of the fruit (**Table 57**).

Table 57. Presence of grit cells sensory assessment scale

State	Presence	Example reference cultivars (IBPGR)
1	Extremely low	Précoce de Trévoux
2	Very low	Beurré Lebrun, Louise Bonne d'Avranches
3	Low	Williams' Bon Chrétien, Ananas de Courtrai, Doyenné du Comice
4	X	Conference
5	Medium	Beurré Bosc
6	X	Précoce Henin
7	High	Kieffer
8	Very high	Saint-Remy
9	Extremely high	

'X': Intermediate rating

5.14 Overall fruit quality (*Priority 1*)

It is an obvious hedonic and relative global evaluation of the fruit quality based on multi-criteria analysis. An assessment should be made of the overall quality of the fully ripe fruit, considering all the individual quality traits. It is important to maintain an objective and comparative approach, and to avoid being influenced by personal tastes (**Table 58**).

Table 58. Overall fruit quality

State	Fruit quality	**Example reference cultivars** (IBPGR)
1	Extremely poor	Saint-Remy
2	Very poor	
3	Poor	
4	Poor to good	Ananas de Courtrai
5	Good	Conference
6	Good to very good	Williams' Bon Chrétien
7	Very good	Précoce de Trévoux, Kristalli, Kontoula
8	X	Beurré Superfin, Louise Bonne d'Avranches
9	Extremely good	Doyenné du Comice

'X': Intermediate rating

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Annex 1

Further guidance on photography

Correct camera settings are essential. **Figure 12** shows how to do it correctly.

Camera setting	✓	✗
Focus		
Exposure		
White balance		

Figure 12 – Correct camera settings

Suggested camera settings

-F25

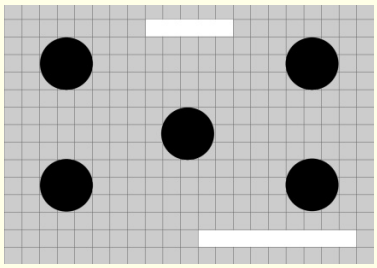
-1/640

-ISO100

Photographs can be taken in two different ways (**Figures 13** and **14**):

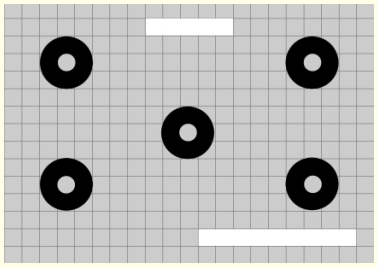
- The first option is appropriate if photographs are needed for a database only
- The second option is appropriate if pictures need to be used for high-quality printing and/or as a reference for identification/verification.

Option 1. Taking all views at once



Print templates available at http://www.clg-champollion-voisins.ac-versailles.fr/IMG/pdf/papiers_millimetres-2.pdf

Attach template on a cardboard box and put holes in cardboard box and template at places where fruits need to be placed

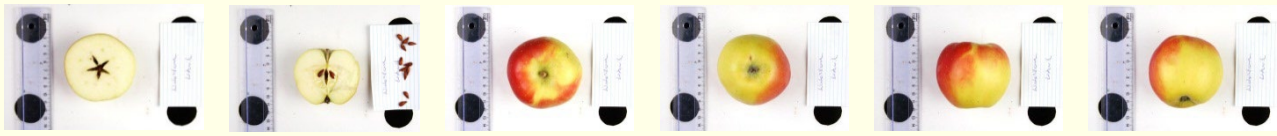


Print templates available at: http://www.clg-champollion-voisins.ac-versailles.fr/IMG/pdf/papiers_millimetres-2.pdf

Use rings (plastic, metal, model clay, …) to place fruits in the right spots

Option 2. Taking all views separately, create a picture with photo-editing software

Take a photograph of every view/angle separately



Resize every picture and cut out the fruit with photo-editing software (Adobe Photoshop or other)

Combine photographs into a picture

Main advantage: → much higher quality

Figure 13. Suggestions for standard photography

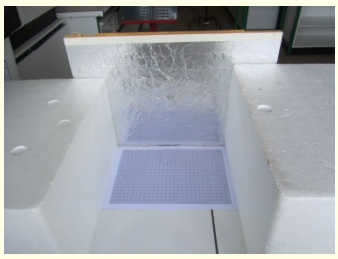
As an alternative, another less sophisticated option for taking fruit pictures is building a simple natural 'light chamber', as illustrated in **Figure 14**.

Choose a room with large windows oriented north or north-west, place a table near the window and build a 'light chamber' with sides being either white or covered with aluminium film. Leave an opening in front of the window as illustrated below.

In north-west European countries, the best quality pictures are obtained between around 10:00 am and 15:00 pm.

1. View of the handmade light chamber

Build your light chamber in front of a north/north-east window.

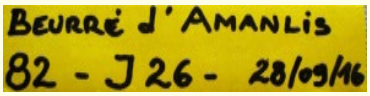


Print grey template available at http://www.clg-champollion-voisins.ac-versailles.fr/IMG/pdf/papiers_millimetres-2.pdf and place it in front of the backplate.

2. Fruit arrangement, label and taking pictures

Use rings (plastic, metal, model clay, etc.) to place fruits at the right spots (here plums as examples).

Put a label with: accession name, accession number, Tree ID, date.



Take the picture in a well perpendicular position with adapted camera tuning and having prior to that regulated the 'white balance'.

Figure 14. Illustration of an alternative way to take fruit pictures