Minimum descriptors for eggplant, *Capsicum* (sweet and hot pepper) and tomato

ECPGR Working Group on Solanaceae

ECPGR Secretariat

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Minimum descriptors for eggplant, *Capsicum* (sweet and hot pepper) and tomato

To describe eggplant, *Capsicum* (sweet and hot pepper) and tomato accessions, ECPGR Solanaceae Working Group members are requested, when possible, to use the minimum set of descriptors proposed here, in addition to their own local descriptors. These descriptors, common to all ECPGR Solanaceae Working Group members, should be provided to the database managers, in order for them to compile and add the data to the central databases of eggplant, *Capsicum* and tomato. This information will provide considerable added value to databases which contain purely passport data sets.

General advice on description is given below, together with three tables providing details on the set of minimum descriptor lists (for eggplant, *Capsicum* and tomato, respectively), as they were agreed by the Solanaceae WG during its *ad hoc* meeting in Bari, Italy (September 2004).

Description of a homogeneous accession

Eggplant, *Capsicum* and tomato are self-pollinating species. Therefore, most of the time, the accessions are homogeneous, all plants are similar and are easy to describe by using the minimum set of descriptors. The description can be made either by looking at one healthy plant representative of the others, but preferably by looking at all the plants in a batch and choosing descriptor states matching the general phenotype of the accession.

Description of a heterogeneous accession

In case of heterogeneity of an accession, the description is much more difficult, and various institutions use different methods to deal with this problem. The ECPGR Solanaceae Working Group is providing here (A) a provisional survey of the different ways heterogeneous Solanaceae accessions are described in Europe, and (B) the current Bioversity International's recommendations in case of heterogeneity.

A. Provisional survey of the different ways heterogeneous Solanaceae accessions are described in Europe

1. If there are only one or two off-type plants (most probably originating from some pollen or seed contamination) they should be discarded. The description should then be made on the plants which have a common or almost common phenotype.
2. If the accession is completely heterogeneous, it is probably a population. This is often the case for accessions like landraces. Hence, the original seed sample is a mixture of different types which were collected as one accession. From a genebank point of view this heterogeneity should be conserved. With regard to the description of such heterogeneous accessions, two methods are in common use, namely (a) accessions are described and conserved in their heterogeneous state, or (b) accessions are subdivided into new accessions that are stabilized by selfing, as described below.

a. Heterogeneity conserved

* If the accession is heterogeneous only in relation to one or a few descriptors, then comment on the heterogeneity in descriptor 12 ('Notes'), and describe this accession by using only the other descriptors for which it is homogeneous (e.g. a set of eggplants can have different fruit shapes and colours, but all plants can be for instance very spiny).

* If the population displays some variation around an "average phenotype", then the descriptors can be recorded as though they are for this average phenotype, while the heterogeneity of the accession should be described with some details in descriptor 12 ('Notes').

* If the accession is highly heterogeneous, then it is very difficult to describe it, because various values of each descriptor will match with the various phenotypes of the different plants. In this case, we advise describing briefly the variation within descriptor 12 ('Notes'). Any detailed description should be abandoned, except for those traits that are relatively constant from one plant to another.

b. Heterogeneity stabilized into different types

If two or more types can easily be distinguished, the accession can be divided into two or more types, as appropriate, and each type should be given a new identification number in the genebank. Each new accession should preferably be selfed in order to become genetically stabilized before being characterized separately. For each new derived type, it is recommended to specify in descriptor 12 ('Notes') from which subdivision of the well-specified initial heterogeneous accession it derives.

As a rule, if an accession is heterogeneous, make a good common sense decision concerning its description. Remember that a description is supposed to characterize an accession morphologically: if you state that you cannot characterize an accession properly, just explain the problem in descriptor 12 ('Notes').

B. Current Bioversity International's recommendations in case of heterogeneity[1]

Recording heterogeneous data

Landraces and wild populations are not as uniform as commercial varieties. Many genebanks will therefore mainly handle accessions that are heterogeneous for many traits (each accession is not genetically uniform and contains a certain amount of variation). Recording the average or most frequently occurring state does not express the extent of variation nor its range within each accession. To a certain extent, this can complicate documentation, since special provision must be made to record the diversity. If statistical studies are foreseen, the best approach is to record actual measurements.

Nevertheless, several other approaches have been proposed to address this issue. In crop descriptor lists, references are made to different methodologies, as discussed below.

- For accessions that are not generally uniform for a descriptor (e.g. a mixed collection, or genetic segregation), the mean and standard deviation can be reported where the

[1] *in* Bioversity International. 2007. Guidelines for the development of crop descriptor lists. Bioversity Technical Bulletin Series. Bioversity International, Rome, Italy. (pp. 38-41) (http://www.bioversityinternational.org/publications/pdf/1226.pdf).

descriptor is continuous. Where the descriptor is discontinuous, several codes in order of frequency could be recorded.

- Another approach is the method developed by van Hintum (1993), which has the following rules:
  - record the scores in decreasing order of size; and
  - add an equals sign (=) after the score if there is only one fraction.

  In this system, homogeneous populations are followed by the '=' sign. For heterogeneous populations, the ratio between two adjacent fractions is taken. If between 1.5 and 5.0, one 'x' sign is placed between the two fractions; if the ratio is higher than 5.0, two 'x' signs are placed.
- The method developed by Sapra and Singh (Rana et al. 1991), proposes the use of numbering codes from 0 to 9 based on frequency encountered (1=very low, 9=very high, with the same scale used for quantitative characters):
  - Three codes are placed in decreasing order of frequency
  - The frequency codes are placed after each descriptor code
  - For homogeneous populations, '9' is placed after the first descriptor code and '0' (indicating absence) after the other two codes.

Example #49	
Flower colour	
1	White
2	Purple
3	Red

For a population with only white flowers, the scores would be 192030. For a population with few (very low) white flowers and many (very high) red flowers, the scores would be 381120.

For descriptors with single digit states (e.g. 1–9 scale), the systems for recording heterogeneity differ and are not completely compatible. At this time, it is unclear to what extent these systems are applied by genebanks.

- Another method, proposing how heterogeneity could be documented for specific traits of the crop, has recently been under development by A. Alercia and co-workers, and is outlined below.

  If an accession shows high variation between plots and within plants, such as the flower colour of *Lathyrus*, the method suggested is to use different columns for each colour, estimate for each plot the percentage of colours present, and record the average. Assign numbering codes for each colour in order of frequency (increasing order).

Example #50

Table 1. Flower colour

Plot No.	Accession No.	Yellow	White	Pink	Red
1	10123	50	10	15	25
2	10123	20	40	30	30
3	10123	30	20	25	25
4	10123	40	30	10	30
5	10123	70	10	10	10
Total		240	110	90	150
%		48%	22%	18%	30%

Assign numbering codes in increasing order using a 1–9 scale (low to high scale), as follows:

Example #51	
1	(18%)
2	(22%)
3	(30%)
4	(48%)

- The descriptor will now will appear as:

Example #52		
Flower colour		
1	Pink	(18%)
2	White	(22%)
3	Red	(30%)
4	Yellow	(48%)

- If, in addition, flower characteristics also show variation between them, it is recommended that they be recorded separately. For example, in Lathyrus species there is a huge variation between accessions, replications and even flowers in the same plot. When this occurs, it is recommended that flower element data be recorded separately:

Example #53	
(i)	Standard colour on upper side
(ii)	Standard colour on lower side
(iii)	Keel colour
(iv)	Wing colour
(v)	Vein colour

- Sometimes, variation may be found on the distribution of colour on standards. In this case, it is suggested to record the variation as follows:

Example #54	
Distribution of colour in the standards	
1	Colour present on margins
2	Colour present in the centre
3	Colour present along the veins

It is recommended that the Royal Horticultural Society Colour Chart be used for colour descriptors. However, in case RHS charts are not available or unaffordable (for example, small collections), using any other standard colour charts or generating one using computer tools is acceptable. When standards different from RHS charts are used, the standards used should be clearly mentioned along with information on colour and in some instances when the charts are uncommon, chart itself may have to be provided along with the information.

Minimum descriptor list for cultivated eggplants (*S. melongena, S. aethiopicum, S. macrocarpon*)

(Bioversity International revised version, approved by the WG)

Bioversity (former IPGRI) descriptor numbers are, where relevant, indicated in the table below (see *Descriptors for Eggplant*, downloadable from : http://www.bioversityinternational.org/publications/pubfile.asp?ID_PUB=401).

This list of descriptors is aimed at describing cultivated eggplants. It is not aimed at identifying wild material (for botanical identification of cultivated eggplants or wild relatives (*Solanum* spp.), contact Gerard van der Weerden [G.vanderWeerden@science.ru.nl] or Marie-Christine Daunay [daunay@avignon.inra.fr]. Information can also be obtained from the following Web sites:

- Nijmegen Botanical Garden (http://www.bgard.sci.kun.nl)
- TROPICOS (http://mobot.mobot.org/W3T/Search/vast.html)
- Mansfeld's World Database of Agricultural and Horticultural Crops (http://mansfeld.ipk-gatersleben.de/mansfeld/Query.htm)
- Tomato Genetic Resources Center (http://tgrc.ucdavis.edu/)
- International Plant Names Index (http://www.ipni.org/ipni/plantnamesearchpage.do).

This descriptor list is aimed only at characterizing morphological traits of cultivated eggplants. Fruit traits must be recorded on physiologically UNRIPE fruits, i.e. when the fruits have reached the developmental stage at which they would be commercialized or eaten ('commercial stage'). Any trace of brown or bright yellow or red or orange colour indicates that the fruit is turning physiologically ripe and therefore must not be used for characterization.

Number	Bioversity (formerly IPGRI) descriptor number	Descriptor name	Descriptor state	Notes
Plant				
1	4.1.3	Plant growth habit	1 Very upright 3 Upright 5 Intermediate 7 Prostrate 9 Very prostrate	*See Fig. 1 below (p. 7).* *This trait is strongly affected by cultural conditions (the comparison to a local reference variety can facilitate the recording of this trait).*
2	4.1.8	Number of leaf prickles (upper surface)	0 None 1 Very few (<3) 3 Few (~4) 5 Intermediate (~8) 7 Many (~15) 9 Very many (>20)	*Count the number of prickles on the upper surface of 2-3 leaves. If they are not visible, count them through touch with fingers to assign the relevant descriptor code and state.*
Fruit				
3	4.2.3 (modified)	Fruit length [cm]		*Record the average fruit length of 10 fully grown fruits (commercial stage), from the base of the calyx to the tip of the fruit.*

Number	Bioversity (formerly IPGRI) descriptor number	Descriptor name	Descriptor state	Notes
4	4.2.4 (modified)	Fruit diameter [cm]		*Record the average fruit diameter of 10 fully grown fruits (commercial stage), at the broadest part.*
5	4.2.10 (modified)	Fruit predominant colour	1 Milk white 2 Yellowish 3 Green 4 Reddish 5 Lilac grey 6 Purple 7 Purple black 8 Black 99 Other (specify the fruit predominant colour)	*Eggplant colour is sometimes difficult to assess, depending on the quantitative combinations between chlorophylls and anthocyanin pigments. Observe several fruits at the commercial stage, and decide which is the predominant colour (i.e. the colour that your eye catches at first sight).* *Use, when available, the Methuen Handbook codes or the Royal Horticultural Society (RHS) colour chart codes.*
6		Fruit additional colour	1 Milk white 2 Yellowish 3 Green 4 Reddish 5 Lilac grey 6 Purple 7 Purple black 8 Black 99 Other (specify the fruit additional colour)	*If the fruit displays a second colour, then code it. If the fruit has only one colour, then enter here the same code as for 5.*
7	4.2.11	Fruit colour distribution	1 Uniform 3 Mottled 5 Netted 7 Striped 99 Other (specify the fruit colour distribution)	*Colour distribution can be very variable. It can be uniform, but in many cases you have to decide whether it is mottled, netted, striped, or intermediate between these, or other (in this case specify the colour pattern).*
8		Fruit flesh colour	1 White 2 Intermediate 3 Green	*Cut the fruit in half and look at the colour of the flesh.*
9		Fruit anthocyanins colour underneath calyx	0 None 1 Very weak 3 Weak 5 Medium 7 Strong 9 Very strong	*This descriptor is interesting to record mostly when anthocyanins (violettish pigments) are present. Remove the calyx of a fruit at commercial stage and note the colour of the fruit epidermis beneath. There, the colour might be as intense as on the other parts of the fruit (9 very strong), or lighter (from 7 strong, to 1 very weak, depending on the intensity difference), or there might be no colour at all.*
10	4.2.15	Fruit calyx prickles	0 None 1 Very few (<3) 3 Few (~5) 5 Intermediate (~10) 7 Many (~20) 9 Very many (>30)	*Number of prickles per calyx. Choose a fruit representative of the accession. Feel manually and count the prickles on the calyx, and choose the appropriate scale (e.g. 15 prickles means code 6).*
Additional information				
11		Photograph		*It is recommended to take a photograph of several fruits, together with a reference scale such as a ruler or a pencil.*
12	11	Notes		*Any original trait not taken into account by the above descriptors should be described here.*

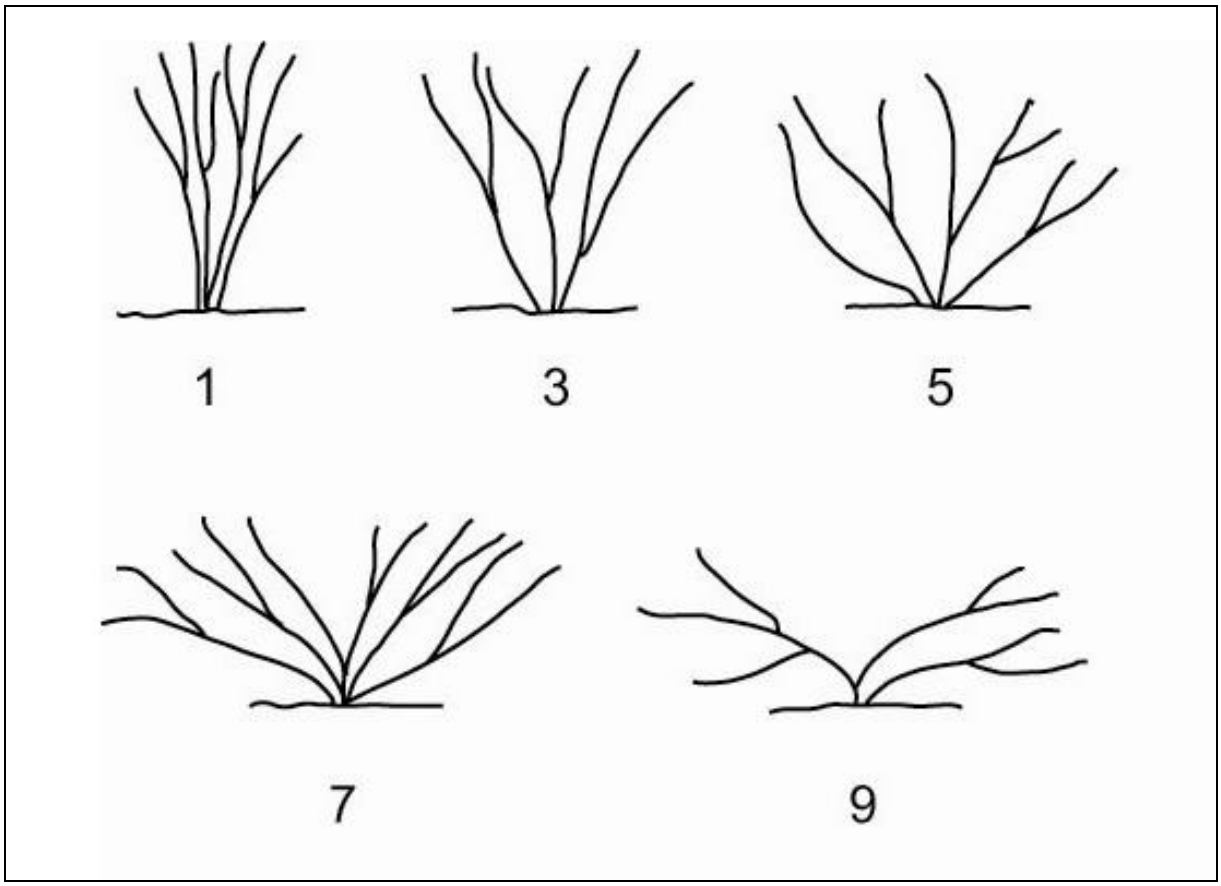

Fig. 1. Plant growth habit

Minimum descriptor list for *Capsicum* spp. (sweet and hot pepper)

(Bioversity International revised version, approved by the WG)

Bioversity (former IPGRI) descriptor numbers are, where relevant, indicated in the table below (see *Descriptors for* Capsicum, downloadable from: http://www. bioversityinternational.org/publications/pubfile+.asp?ID_PUB=345).

This list of descriptors is not aimed at identifying the botanical identity of the material described. For botanical identification see Appendix II *in* "Genetic resources of *Capsicum"* (IBPGR 1983[2]). This document has been revised and updated by A. Palloix (INRA, Montfavet, France) and P. Bosland (New Mexico State University), and can be found in Table 1 below (p. 10).

This descriptor list is aimed only at characterizing morphological traits of cultivated material.

Number	Bioversity (formerly IPGRI) descriptor number	Descriptor name	Descriptor state	Notes
Plant				
1	7.1.2.7	Plant growth habit	3 Erect 5 Intermediate 7 Prostrate 99 Other (specify the plant growth habit)	*Observed when 50% of the plants bear ripe fruits.*
2	7.1.2.6	Plant height [cm]	1 <25 2 25-45 3 46-65 4 66-85 5 >85	*Recorded when on 50% of the plants the first fruit has begun to ripen.*
Inflorescence				
3	7.2.1.2	Number of flowers per axil	1 One 2 Two 3 Three or more 4 Many flowers in bunches but each in individual axil (fasciculate growth) 99 Other (i.e. cultivars with two flowers in the first axil and with one only in the other) (specify the number of flowers per axil)	

[2] IBPGR. 1983. Genetic resources of *Capsicum* - a global plan of action. FAO-AGPG-IBPGR/82/12. International Board for Plant Genetic Resources, Rome ,Italy.

Number	Bioversity (formerly IPGRI) descriptor number	Descriptor name	Descriptor state	Notes
4	7.2.1.4	Corolla colour	1 White 2 Light yellow 3 Yellow 4 Yellow-green 5 Purple with white base 6 White with purple base 7 White with purple margin 8 Purple 99 Other (specify the corolla colour)	
Fruit				
5	7.2.2.3	Fruit colour at intermediate stage	1 White 2 Yellow 3 Green 4 Orange 5 Purple 6 Deep purple 99 Other (specify the fruit colour at intermediate stage)	
6	7.2.2.6	Fruit colour at mature stage	1 White 2 Lemon-yellow 3 Pale orange-yellow 4 Orange yellow 5 Pale orange 6 Orange 7 Light red 8 Red 9 Dark red 10 Purple 11 Brown 12 Black 99 Other (specify the fruit colour at mature stage)	
7	7.2.2.7	Fruit shape	1 Elongate 2 Almost round 3 Triangular 4 Campanulate 5 Blocky (Oblong) 99 Other (specify the fruit shape)	*See Fig. 11, p. 34 of Descriptors for* Capsicum.
8	7.2.2.8	Fruit length [cm]		*Average fruit length of 10 ripe fruits of the second harvest.*
9	7.2.2.9	Fruit width [cm]		*Measure at the widest point. Average fruit width of 10 ripe fruits of the second harvest.*
10	7.2.2.19	Fruit surface	1 Smooth 2 Semi-wrinkled 3 Wrinkled	*Recorded at physiological maturity.*
Additional information				
11		Photograph		*It is recommended to take a photograph of several fruits, together with a reference scale such as a ruler or a pencil.*
12	7.4	Notes		*Any original trait not taken into account by the above descriptors should be described here.*

Table 1. Botanical identification for *Capsicum* spp.

Species	Wild (W) or cultivated (C)	Wild distribution	Corolla			Calyx		Flowers		Seed colour	Leaf		Anther colour
			Colour	Throat colour	Shape	Ridges	Teeth	No. per nodes	Position		Surface	Pubescence	
annuum	C, W	S USA to N Peru	White	-	Rotate	Moderate	Small	1	Various	Tan	Smooth	Smooth to pubescent	Blue or white
chinense	C, W	Upper Amazon	White trace of yellow	-	Rotate	Light, calyx constriction	Small	2-5	Various	Tan	Rugose	None	Blue
frutescens	C, W	Mexico to Central Brazil	Waxy greenish	-	Rotate	Light	None	1-5	Stiffly erect	Tan	Smooth	None	Blue
galapagoense	W	Galapagos Islands	White	-	Rotate	Trace	None	1-2	Pending	Tan	Smooth	Strongly	White
chacoense	W	S Bolivia to N Argentina	White	-	Rotate	Moderate	10 sharp teeth	1	Erect	Tan	Smooth	None	Yellow
pubescens	C	Mexico to Central Brazil	Purple	White	Rotate	Light	1 mm	1-2	Various	Black	Rugose	Strongly	Purple
cardenasii	W	Bolivia	Lavender	2 Yellow spots	Bell	Light	2 mm	1-2	Erect	Brown	Smooth	None	Purple
eximium	W	Bolivia and N Argentina	White to lavender	Green-yellow spots	Bell	Moderate	2 mm	3-5	Erect	Brown	Smooth	None to moderate	White with trace blue
tovarii	W	Central Brazil	Waxy pale green	2 Green-yellow spots	Bell	Light	None	5-6	Various	Tan	Lightly rugose	None	Blue
praetermissum	W	Central Brazil	White, pale blue	2 Green-yellow spots	Rotate	Light	1 mm	1-3	Erect	Tan	Lightly rugose	Moderate	White
baccatum	C, W	Bolivia, SW Brazil, SE Peru	White	2 Green-yellow spots	Rotate	Light	1 mm	1-2	various	Tan	Smooth	None	Yellow
schottianum	W	NE Argentina SW Brazil	White	Green	Rotate	Indistinct	None	2-3	Various	Black	Smooth	None	Yellow
buforum	W	SW Brazil	White to lavender	Green	Rotate	Light	2-3 mm	2-5	Various	Black	Smooth	None	Yellow

Minimum descriptor list for tomato (*Lycopersicon esculentum* Mill.)

(Bioversity International revised version, approved by the WG)

Bioversity (former IPGRI) descriptor numbers are, where relevant, indicated in the table below (see *Descriptors for Tomato,* downloadable from: http://www.bioversityinternational.org/publications/pubfile.asp?ID_PUB=286).

This list of descriptors is not aimed at identifying the botanical identity of the material described (for botanical identification see the key to the tomato species available on the Web site of the Tomato Genetics Resource Center (TGRC, University of California, Davis) at http://tgrc.ucdavis.edu/key.html).

This descriptor list is aimed only at characterizing morphological traits of cultivated material.

Number	Bioversity (formerly IPGRI) descriptor number	Descriptor name	Descriptor state	Notes
Plant				
1	7.1.2.1 (modified)	Plant growth type	1 Determinate 2 Semi-determinate 3 Indeterminate	*Recorded at complete developmental stage of the plant. Observed on the whole plot, after admixtures have been removed.*
2	7.1.2.9 (modified)	Leaf type	1 Dwarf 2 Potato leaf type 3 Standard 99 Other (specify the leaf type)	*See Fig. 3, p. 26 of Descriptors for Tomato.*
Inflorescence				
3	7.2.1.1 (modified)	Inflorescence type	1 Generally simple (uniparous) 2 Generally two branches 3 Three or more branches	*Observe the 2nd and 3rd inflorescence of at least 10 plants.*
Fruit				
4	7.2.2.2 (modified)	Presence / absence of dark green stripes on the (shoulders) fruit	0 Absent (uniform ripening) 1 Present (fruit shoulder or stripes – upper part of the fruit, around calyx – are DARK green while pistillar area of the fruit is LIGHT green)	*The observation must be made on unripe fruits.*
5	7.2.2.5	Predominant fruit shape	1 Flattened (oblate) 2 Slightly flattened 3 Rounded 4 High rounded 5 Heart-shaped 6 Cylindrical (long oblong) 7 Pyriform 8 Ellipsoid (plum shaped) 99 Other (specify the predominant fruit shape)	*Recorded after the fruit turns colour (see Fig. 4, p. 29 of Descriptors for Tomato).*
6	7.2.2.8	Fruit weight [g]		*Average of 10 ripe fruits.*

Number	Bioversity (formerly IPGRI) descriptor number	Descriptor name	Descriptor state	Notes
7	7.2.2.11	Exterior colour of fruit	1 Green 2 Yellow 3 Orange 4 Pink 5 Red 99 Other (specify the exterior colour of fruit)	*Recorded at physiological maturity.*
8	7.2.2.14	Ribbing at calyx end	1 Very weak 3 Weak 5 Intermediate 7 Strong	*Recorded when the fruit reaches its maximum size* *Reference varieties:* *Cerise (1)* *Allround (3)* *Saint-Pierre (5)* *Supermarmande (7)*
9	7.2.2.19	Presence / absence of jointless pedicel	0 Absent 1 Present	*See Fig. 6, p. 32 of Descriptors for Tomato, corresponding to Descriptor 7.2.2.18.*
10	7.2.2.31	Number of locules per fruit		*Counted on at least 10 fruits.*
Additional information				
11		Photograph		*It is recommended to take a photograph of several fruits, together with a reference scale such as a ruler or a pencil.*
12	7.4	Notes		*Any original trait not taken into account by the above descriptors should be described here.*