CPVO · OCVV
Community Plant Variety Office
Office Communautaire des Variétés Végétales

PROTOCOL FOR TESTS ON DISTINCTNESS, UNIFORMITY AND STABILITY

Solanum tuberosum L.

POTATO

UPOV Code: SOLAN_TUB

Adopted on 15/03/2017

Entry into force on 01/12/2016

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CPVO-TP/023/3

1. SUBJECT OF THE PROTOCOL AND REPORTING

1.1 Scope of the technical protocol

This Technical Protocol applies to all varieties of ***Solanum tuberosum* L.**

The protocol describes the technical procedures to be followed in order to meet the requirements of Council Regulation 2100/94 on Community Plant Variety Rights. The technical procedures have been agreed by the Administrative Council and are based on documents agreed by the International Union for the Protection of New Varieties of Plants (UPOV), such as the General Introduction to DUS (UPOV Document TG/1/3 http://www.upov.int/en/publications/intro_dus.htm), its associated TGP documents
(http://www.upov.int/en/publications/tgp/) and the relevant UPOV Test Guideline TG/023/6 dated 31/03/2004 (http://www.upov.int/edocs/tgdocs/en/tg023.pdf) for the conduct of tests for Distinctness, Uniformity and Stability.

1.2 Entry into Force

The present protocol enters into force on **01/12/2016**. Any ongoing DUS examination of candidate varieties started before the aforesaid date will not be affected by the approval of the Technical Protocol. Technical examinations of candidate varieties are carried out according to the TP in force when the DUS test starts. The starting date of a DUS examination is considered to be the due date for submitting of plant material for the first test period.

In cases where the Office requests to take-over a DUS report for which the technical examination has either been finalized or which is in the process to be carried out at the moment of this request, such report can only be accepted if the technical examination has been carried out according to the CPVO TP which was in force at the moment when the technical examination started.

1.3 Reporting between Examination Office and CPVO and Liaison with Applicant

1.3.1 Reporting between Examination Office and CPVO

The Examination Office shall deliver to the CPVO a preliminary report ("the preliminary report") no later than two weeks after the date of the request for technical examination by the CPVO.

The Examination Office shall also deliver to the CPVO a report relating to each growing period ("the interim report") and, when the Examination Office considers the results of the technical examination to be adequate to evaluate the variety or the CPVO so requests, a report relating to the examination ("the final report").

The final report shall state the opinion of the Examination Office on the distinctness, uniformity and stability of the variety. Where it considers those criteria to be satisfied, or where the CPVO so requests, a description of the variety shall be added to the report. If a report is negative the Examination Office shall set out the detailed reasons for its findings.

The interim and the final reports shall be delivered to the CPVO as soon as possible and no later than on the deadlines as laid down in the designation agreement.

1.3.2 Informing on problems in the DUS test

If problems arise during the course of the test the CPVO should be informed immediately so that the information can be passed on to the applicant. Subject to prior permanent agreement, the applicant may be directly informed at the same time as the CPVO particularly if a visit to the trial is advisable.

1.3.3 Sample keeping in case of problems

If the technical examination has resulted in a negative report, the CPVO shall inform the Examination Office as soon as possible in case that a representative sample of any relevant testing material shall be kept.

2. MATERIAL REQUIRED

2.1 Plant material requirements

Information with respect to the agreed closing dates and submission requirements of plant material for the technical examination of varieties can be found on http://www.cpvo.europa.eu/main/en/home/documents-and-publications/s2-gazette in the special issue S2 of the Official Gazette of the Office. General requirements on submission of samples are also to be found following the same link.

2.2 Informing the applicant of plant material requirements

The CPVO informs the applicant that

- he is responsible for ensuring compliance with any customs and plant health requirements.
- the plant material supplied should be visibly healthy, not lacking in vigour, nor affected by any important pest or disease.
- the plant material should not have undergone any treatment which would affect the expression of the characteristics of the variety, unless the competent authorities allow or request such treatment. If it has been treated, full details of the treatment must be given.

2.3 Informing about problems on the submission of material

The Examination Office shall report to the CPVO immediately in cases where the test material of the candidate variety has not arrived in time or in cases where the material submitted does not fulfil the conditions laid down in the request for material issued by the CPVO.

In cases where the examination office encounters difficulties to obtain plant material of reference varieties the CPVO should be informed.

3. METHOD OF EXAMINATION

3.1 Number of growing cycles

The minimum duration of tests should normally be two independent growing cycles.

3.2 Testing Place

Tests are normally conducted at one place. In the case of tests conducted at more than one place, guidance is provided in TGP/9 "Examining Distinctness"
http://www.upov.int/export/sites/upov/en/publications/tgp/documents/tgp_9_1.pdf.

3.3 Conditions for Conducting the Examination

The tests should be carried out under conditions ensuring satisfactory growth for the expression of the relevant characteristics of the variety and for the conduct of the examination.

The optimum stage of development for the assessment of each characteristic is indicated by a number in the third column of the Table of Characteristics. The stages of development denoted by each number are described in Chapter 8.3

3.4 Test design

Each test should be designed to result in a total of at least 60 plants, which should be divided between at least 2 replicates. The assessment of lightsprout characteristics should be carried out on at least 5 tubers.

3.5 Additional tests

In accordance with Article 83(3) of Council Regulation No. 2100/94 an applicant may claim either in the Technical Questionnaire or during the test that a candidate has a characteristic which would be helpful in establishing distinctness. If such a claim is made and is supported by reliable technical data, an additional test may be undertaken providing that a technically acceptable test procedure can be devised.

Additional tests will be undertaken, with the agreement of the President of CPVO, where distinctness is unlikely to be shown using the characters listed in the protocol.

3.6 Constitution and maintenance of a variety collection

The process for the constitution and the maintenance of a variety collection can be summarized as follows:

Step 1: Making an inventory of the varieties of common knowledge

Step 2: Establishing a collection ("variety collection") of varieties of common knowledge which are relevant for the examination of distinctness of candidate varieties

Step 3: Selecting the varieties from the variety collection which need to be included in the growing trial or other tests for the examination of distinctness of a particular candidate variety.

3.6.1 Forms of variety collection
The variety collection shall comprise variety descriptions; no living reference collection is required. The variety description shall be produced by the EO unless special cooperation exists between EOs and the CPVO. The descriptive and pictorial information produced by the EO shall be held and maintained in a form of a database.

3.6.2 Living Plant Material
The EO shall obtain living plant material of reference varieties as and when those varieties need to be included in growing trials or other tests.

3.6.3 Range of the variety collection
The living variety collection shall cover at least those varieties that are suitable to climatic conditions of a respective EO.

3.6.4 Making an inventory of varieties of common knowledge for inclusion in the variety collection
The inventory shall take into account the list of protected varieties and the official, or other, registers of varieties, in particular:

The inventory shall include varieties protected under National PBR (UPOV contracting parties) and Community PBR, varieties registered in the Common Catalogue, the OECD list, the Conservation variety list and varieties in trade or in commercial registers for those species not covered by a National or the Common Catalogue.

4. ASSESSMENT OF DISTINCTNESS, UNIFORMITY AND STABILITY

The prescribed procedure is to assess distinctness, uniformity and stability in a growing trial.

4.1 Distinctness

4.1.1 General recommendations
It is of particular importance for users of this Technical Protocol to consult the UPOV-General Introduction to DUS (link in chapter 1 of this document) and TGP 9 'Examining Distinctness' (http://www.upov.int/export/sites/upov/en/publications/tgp/documents/tgp_9_1.pdf) prior to making decisions regarding distinctness. However, the following points are provided for elaboration or emphasis in this Technical Protocol.

4.1.2 Consistent differences
The differences observed between varieties may be so clear that more than one growing cycle is not necessary. In addition, in some circumstances, the influence of the environment is not such that more than a single growing cycle is required to provide assurance that the differences observed between varieties are sufficiently consistent. One means of ensuring that a difference in a characteristic, observed in a growing trial, is sufficiently consistent is to examine the characteristic in at least two independent growing cycles.

4.1.3 Clear differences
Determining whether a difference between two varieties is clear depends on many factors, and should consider, in particular, the type of expression of the characteristic being examined, i.e. whether it is expressed in a qualitative, quantitative, or pseudo-qualitative manner. Therefore, it is important that users of these Technical Protocols are familiar with the recommendations contained in the UPOV-General Introduction to DUS prior to making decisions regarding distinctness.

Decision standards

4.1.4 Number of plants/parts of plants to be examined
Unless otherwise indicated, for the purposes of distinctness, all observations should be made on all plants in the test, disregarding any off-type plants.

4.1.5 Method of observation
The recommended method of observing the characteristic for the purposes of distinctness is indicated by the following key in the third column of the Table of Characteristics (see document TGP/9 "Examining Distinctness", Section 4 "Observation of characteristics"):

MG: single measurement of a group of plants or parts of plants
VG: visual assessment by a single observation of a group of plants or parts of plants

Type of observation: visual (V) or measurement (M)
"Visual" observation (V) is an observation made on the basis of the expert's judgment. For the purposes of this document, "visual" observation refers to the sensory observations of the experts and, therefore, also includes smell, taste and touch. Visual observation includes observations where the expert uses reference points (e.g. diagrams, example varieties, side-by-side comparison) or non-linear charts (e.g. colour charts). Measurement (M) is an objective observation against a calibrated, linear scale e.g. using a ruler, weighing scales, colorimeter, dates, counts, etc.

Type of record: for a group of plants (G) or for single, individual plants (S)
For the purposes of distinctness, observations may be recorded as a single record for a group of plants or parts of plants (G), or may be recorded as records for a number of single, individual plants or parts of plants (S). In most cases, "G" provides a single record per variety and it is not possible or necessary to apply statistical methods in a plant-by-plant analysis for the assessment of distinctness."

In cases where more than one method of observing the characteristic is indicated in the Table of Characteristics (e.g. VG/MG), guidance on selecting an appropriate method is provided in document TGP/9, Section 4.2.

4.2 Uniformity

It is of particular importance for users of this Technical Protocol to consult the UPOV-General Introduction to DUS (link in chapter 1 of this document) and TGP 10 'Examining Uniformity' (http://www.upov.int/export/sites/upov/en/publications/tgp/documents/tgp_10_1.pdf) prior to making decisions regarding uniformity. However, the following points are provided for elaboration or emphasis in this Technical Protocol:

For the assessment of uniformity, a population standard of 1 % and an acceptance probability of at least 95 % should be applied. In the case of a sample size of 60 plants, 2 off-types are allowed. In a sample size of 5 plants no off-type is allowed.

4.3 Stability

4.3.1 It is of particular importance for users of this Technical Protocol to consult the UPOV-General Introduction to DUS (link in chapter 1 of this document) and TGP 11 'Examining Stability' (http://www.upov.int/export/sites/upov/en/publications/tgp/documents/tgp_11_1.pdf)
In practice, it is not usual to perform tests of stability that produce results as certain as those of the testing of distinctness and uniformity. However, experience has demonstrated that, for many types of variety, when a variety has been shown to be uniform, it can also be considered to be stable.

Where appropriate, or in cases of doubt, stability may be further examined by testing a new seed or plant stock to ensure that it exhibits the same characteristics as those shown by the initial material supplied.

5. GROUPING OF VARIETIES AND ORGANIZATION OF THE GROWING TRIAL

5.1 The selection of varieties of common knowledge to be grown in the trial with the candidate varieties and the way in which these varieties are divided into groups to facilitate the assessment of distinctness are aided by the use of grouping characteristics.

5.2 Grouping characteristics are those in which the documented states of expression, even where produced at different locations, can be used, either individually or in combination with other such characteristics: (a) to select varieties of common knowledge that can be excluded from the growing trial used for examination of distinctness; and (b) to organize the growing trial so that similar varieties are grouped together.

5.3 The following have been agreed as useful grouping characteristics.

a) Lightsprout: proportion of blue in anthocyanin colouration of base (characteristic 4)

b) Flower corolla: intensity of anthocyanin colouration on inner side (characteristic 27)

c) Flower corolla: proportion of blue in anthocyanin colouration on inner side (characteristic 28)

d) Plant: time of maturity (characteristic 31)

e) Tuber: colour of skin (characteristic 34)

5.4 If other characteristics than those from the TP are used for the selection of varieties to be included into the growing trial, the EO shall inform the CPVO and seek the prior consent of the CPVO before using these characteristics.

6. INTRODUCTION TO THE TABLE OF CHARACTERISTICS

6.1 Characteristics to be used

The characteristics to be used in DUS tests and preparation of descriptions shall be those referred to in the table of characteristics. All the characteristics shall be used, providing that observation of a characteristic is not rendered impossible by the expression of any other characteristic, or the expression of a characteristic is prevented by the environmental conditions under which the test is conducted or by specific legislation on plant health. In the latter case, the CPVO should be informed.

The Administrative Council empowers the President, in accordance with Article 23 of Commission Regulation N°874/2009, to insert additional characteristics and their expressions in respect of a variety.

States of expression and corresponding notes
In the case of qualitative and pseudo-qualitative characteristics, all relevant states of expression are presented in the characteristic. However, in the case of quantitative characteristics with 5 or more states, an abbreviated scale may be used to minimize the size of the Table of Characteristics. For example, in the case of a quantitative characteristic with 9 states, the presentation of states of expression in the Test Guidelines may be abbreviated as follows:

State	Note
small	3
medium	5
large	7

However, it should be noted that all of the following 9 states of expression exist to describe varieties and should be used as appropriate:

State	Note
very small	1
very small to small	2
small	3
small to medium	4
medium	5
medium to large	6
large	7
large to very large	8
very large	9

6.2 Example Varieties

Where appropriate, example varieties are provided to clarify the states of expression of each characteristic.

6.3 Legend

For the CPVO N° column:
G Grouping characteristic – see Chapter 5
QL Qualitative characteristic
QN Quantitative characteristic
PQ Pseudo-qualitative characteristic
(a) – (f) See Explanations on the Table of Characteristics in Chapter 8.1
(+) See Explanations on the Table of Characteristics in Chapter 8.2

For the UPOV N° column:
The numbering of the characteristics is provided as a reference to the ad hoc UPOV guideline.
(*) UPOV Asterisked characteristic – Characteristics that are important for the international harmonisation of variety descriptions.

For the column "stage, method":
09 – 99 See Explanations on the Table of Characteristics in Chapter 8.3
MG, VG Method of observation – see Chapter 4.1.5

7. TABLE OF CHARACTERISTICS

CPVO N°	UPOV N°	Stage, Method	Characteristics	Examples	Note
1.	**1.**		**Lightsprout: size**		
(+)		**VG**	small	Laura	3
QN		**(a)**	medium	Diamant, Victoria	5
			large	Solist	7
2.	**2.**		**Lightsprout: shape of base**		
(+)	**(*)**	**VG**	spherical	Albatros	1
PQ		**(a)**	ovoid	Laura, Marabel	2
			conical	Bintje, Solist	3
			broad cylindrical	Diamant, Innovator	4
			narrow cylindrical	Valfi	5
3.	**3. (*)**		**Lightsprout: anthocyanin colouration of base**		
QN		**VG**	absent or very weak	Estima	1
		(a), (f)	weak	Santé, Solist	3
			medium	Arielle	5
			strong	Abbot, Granola, Victoria	7
			very strong	Avano	9
4.	**4.**		**Lightsprout: proportion of blue in anthocyanin colouration of base**		
(+)	**(*)**	**VG**	absent or low	Arielle, Desiree, Solist, Victoria	1
QN		**(a)**	medium	Abbot, Pamina	2
G			high	Agria, Avano	3
5.	**5.**		**Lightsprout: pubescence of base**		
(+)	**(*)**	**VG**	absent or very weak	Valfi	1
QN		**(a)**	weak	Goldmarie	3
			medium	Albatros, Laura	5
			strong	Abbot	7
			very strong	Oxania	9

CPVO N°	UPOV N°	Stage, Method	Characteristics	Examples	Note
6.	**6.**		**Lightsprout: size of tip in relation to base**		
(+)		**VG**	small	Laura	3
QN		**(a)**	medium	Albatros, King Edward, Ukama	5
			large	Abbot, Erntestolz	7
7.	**7.**		**Lightsprout: habit of tip**		
(+)		**VG**	closed	Laura	1
QN		**(a)**	intermediate	Arielle, Rita	3
			open	Diamant, Solist	5
8.	**8.**		**Lightsprout: anthocyanin colouration of tip**		
(+)		**VG**	absent or very weak	Estima, Innovator	1
QN		**(a), (f)**	weak	Solist	3
			medium	Laura, Spunta	5
			strong	Agria	7
			very strong	Valfi	9
9.	**9.**		**Lightsprout: pubescence of tip**		
(+)		**VG**	absent or very weak	Goldmarie	1
QN		**(a)**	weak	Laura, Valfi	3
			medium	Albatros	5
			strong	Abbot	7
			very strong	Camilla	9
10.	**10.**		**Lightsprout: number of root tips**		
(+)	**(*)**	**VG**	few	Estima, , Solist	3
QN		**(a)**	medium	Arielle, Bintje	5
			many	Innovator	7

CPVO N°	UPOV N°	Stage, Method	Characteristics	Examples	Note
11.	**11.**		**Lightsprout: length of lateral shoots**		
(+)		**VG**	short	Laura, Producent	3
QN		**(a)**	medium	Estima, Princess	5
			long	Spunta	7
12.	**12.**	**51-69**	**Plant: foliage structure**		
(+)		**VG**	stem type	Agria, Estima	1
QN			intermediate type	Premiere	2
			leaf type	Kennebec	3
13.	**13.**	**51-69**	**Plant: growth habit**		
(+)	**(*)**	**VG**	upright	Victoria	3
QN			semi-upright	Desiree, Secura	5
			spreading	Solist	7
14.	**14.**	**51-69**	**Stem: anthocyanin colouration**		
(+)	**(*)**	**VG**	absent or very weak	Estima	1
QN		**(f)**	weak	Atlantic, Victoria	3
			medium	Laura, Saturna	5
			strong	Desiree	7
			very strong	Valfi	9
15.	**15.**	**51-69**	**Leaf: outline size**		
(+)		**VG**	small	Kingston	3
QN		**(b)**	medium	Laura	5
			large	Kennebec	7
16.	**16.**	**51-69**	**Leaf: openness**		
(+)		**VG**	closed	Albatros, Likaria	1
QN		**(b)**	intermediate	Premiere, Solist	3
			open	Goldmarie	5

CPVO N°	UPOV N°	Stage, Method	Characteristics	Examples	Note
17.	**17.**	**51-69**	**Leaf: presence of secondary leaflets**		
(+)		**VG**	weak	Solara, Goldmarie	3
QN		**(b)**	medium	Solist	5
			strong	Hercules, Victoria	7
18.	**18.**	**51-69**	**Leaf: green colour**		
(+)		**VG**	light	Solist	3
QN		**(c)**	medium	Ulme, Victoria	5
			dark	Spunta	7
19.	**19.**	**51-69**	**Leaf: anthocyanin colouration on midrib of upper side**		
(+)		**VG**	absent or very weak	Solist	1
QN		**(b), (f)**	weak	Avano, Russet Burbank	3
			medium	Laura	5
			strong	Romanze	7
			very strong	Bildtstar, Roseval	9
20.	**21.**	**51-69**	**Second pair of lateral leaflets: width in relation to length**		
(+)		**VG**	narrow	Innovator, Russet Burbank	3
QN		**(b)**	medium	Desiree	5
			broad		7
21.	**22.**	**51-69**	**Terminal and lateral leaflets: frequency of coalescence**		
(+)		**VG**	absent or very low	Courage	1
QN		**(c)**	medium	Goldmarie	3
			very high	Cardinia	5

CPVO N°	UPOV N°	Stage, Method	Characteristics	Examples	Note
22.	**27.**	**55**	**Flower bud: anthocyanin colouration**		
(+)		**VG**	absent or very weak	Solist	1
QN		**(f)**	weak	Panda	3
			medium	Victoria	5
			strong	Osprey	7
			very strong	Valfi	9
23.	**29.**	**60-69**	**Plant: frequency of inflorescences**		
	(*)	**VG**	absent or very low	King Edward, Rosalind	1
QN			low	Arielle	3
			medium	Laura, Rita	5
			high	Agria, Innovator	7
			very high	Sibu	9
24.	**30.**	**60-69**	**Inflorescence: size**		
(+)		**VG**	small	Accent, Solist, Estima	3
QN			medium	Rubesse	5
			large	Innovator	7
25.	**31.**	**60-69**	**Inflorescence: anthocyanin colouration on peduncle**		
(+)		**VG**	absent or very weak	Solist, Estima	1
QN		**(f)**	weak	Victoria	3
			medium	Saturna	5
			strong	Desiree	7
			very strong	Blaue St. Galler	9
26.	**32.**	**60-69**	**Flower corolla: size**		
(+)		**VG**	very small		1
QN		**(d)**	small	Sommergold, Avano	3
			medium	Laura	5
			large	Innovator	7
			very large	Rioja, Roseval	9

CPVO N°	UPOV N°	Stage, Method	Characteristics	Examples	Note
27.	**33.**	**60-69**	**Flower corolla: <u>intensity</u> of anthocyanin colouration on inner side**		
(+)	**(*)**	**VG**	absent or very weak	Solist	1
QN		**(d), (f)**	weak	Laura, Pirol, Secura	3
			medium	Quadriga, Osprey	5
			strong	Courage, Valfi	7
G			very strong	Ramona	9
28.	**34.**	**60-69**	**Flower corolla: proportion of blue in anthocyanin colouration on inner side**		
(+)	**(*)**	**VG**	absent or low	Laura, Osprey	1
QN		**(d)**	medium	Courage, Secura	2
G			high	Pirol, Quadriga, Valfi	3
29.	**35.**	**60-69**	**Flower corolla: <u>extent</u> of anthocyanin colouration on inner side**		
(+)	**(*)**	**VG**	absent or very small		1
QN		**(d)**	small	Laura	3
			medium	Pirol	5
			large	Panda	7
			very large	Courage	9
30.	**28.**	**65-69**	**Plant: height**		
QN		**VG**	very short	Mimi	1
			short		2
			medium	Arielle, Leyla	3
			tall		4
			very tall	Panda	5

CPVO N°	UPOV N°	Stage, Method	Characteristics	Examples	Note
31.	**36.**	**97**	**Plant: time of maturity**		
(+)	**(*)**	**MG**	very early	Christa, Solist	1
QN			early	Cilena, Courage	3
			medium	Laura, Nicola	5
			late	Avano	7
G			very late	Producent, Kuras	9
32.	**37.**	**99**	**Tuber: shape**		
(+)	**(*)**	**VG**	round	Kuras	1
QN		**(e)**	short-oval	Courage	2
			oval	Diamant, Rubesse	3
			long-oval	Linda, Innovator	4
			long	Spunta	5
			very long	Pompadour	6
33.	**38.**	**99**	**Tuber: depth of eyes**		
QN		**VG**	very shallow	Nadine	1
		(e)	shallow	Agria, Innovator	3
			medium	Courage, Erntestolz	5
			deep	Elles, Kuras	7
			very deep		9
34.		**99**	**Tuber: colour of skin**		
PQ		**VG**	light beige	Nadine	1
G		**(e)**	yellow	Solist	2
			reddish brown	SF Balu	3
			light red	Rosalind	4
			medium red	Laura	5
			dark red	Romanze	6
			red parti coloured	Cara	7
			blue	Valfi	8
			blue parti coloured	Catriona, Kestrel	9

CPVO N°	UPOV N°	Stage, Method	Characteristics	Examples	Note
35		**99**	**Tuber: smoothness of skin**		
QN		**VG**	smooth	SF Balu	1
		(e)	medium	Solist	2
			rough	Ivory Russet	3
36.	**40.**	**99**	**Tuber: colour of base of eye**		
PQ	**(*)**	**VG**	white	Nadine	1
		(e)	yellow	Agria, Solist	2
			red	Quarta, Romanze	3
			blue	Purple Majesty	4
37.	**41.**	**99**	**Tuber: colour of flesh**		
(+)	**(*)**	**VG**	white	Kuras, Russet Burbank	1
PQ		**(e)**	cream	Desiree, Estima	2
			light yellow	Diamant, Solist	3
			medium yellow	Bildtstar, Quarta	4
			dark yellow	Princess, Laura	5
			red	Red Emmallie	6
			red parti-coloured	Early Rose	7
			blue	Purple Majesty	8
			blue parti-coloured	Herd Laddie	9

8. EXPLANATIONS ON THE TABLE OF CHARACTERISTICS

8.1 Explanations covering several characteristics

Characteristics containing the following key in the third column of the Table of Characteristics should be examined as indicated below:

(a) Lightsprouts (Characteristics 1 – 11):
Dormancy of the tubers and other external factors such as temperature and light conditions may influence the observations.

Number of tubers for lightsprout characteristics: All observations on the lightsprout should be made on a total of 5 tubers as a minimum.

Set up of the lightsprout cabinet: The spectrum and the intensity of the light source are the most important factors for the expression of lightsprout characteristics. This spectrum is defined by the type of lamps and the voltage used. When extremes of temperature are avoided, the influence of the temperature is small. A good expression of characteristics is obtained when the lightsprouts are grown in a light-sealed cabinet at room temperature under continuous light provided by small incandescent bulbs under controlled conditions:
- Temperature: around 20C°
- Relative humidity: 50 - 70%
- Light source: small incandescent bulbs (6V AC/0.05 A)
- Light intensity: 7 to 11 lux (approximately 7-10 bulbs per square meter)
- Distance between top of the tubers and the light bulbs: 20 to 30 cm

Observations should be made in a room with indirect day light when the characteristics 7 (habit of tip) and 11 (length of lateral shoots) have reached their maximum differentiation. Example varieties should be used to determine the optimal stage for observations.

The development of lightsprouts depends on the time of test after harvest. Development increases with age of tubers. If the test is started already about 100 days after harvest, the appropriate stage for observations might be reached only after about 14 weeks due to dormancy and/or slow development. If the test is started later, the appropriate stage for observations might be reached after a shorter period.

(b) Leaf (Characteristics 15 – 17; 19, 20): All observations should be made on fully developed leaves from the centre of the plant. One leaf from each of 10 plants should be picked from a main stem midway between the top and the bottom of the plant.

(c) Leaf (Characteristic 18 + 21): All observations should be made on fully developed leaves in the centre of the plant (middle third).

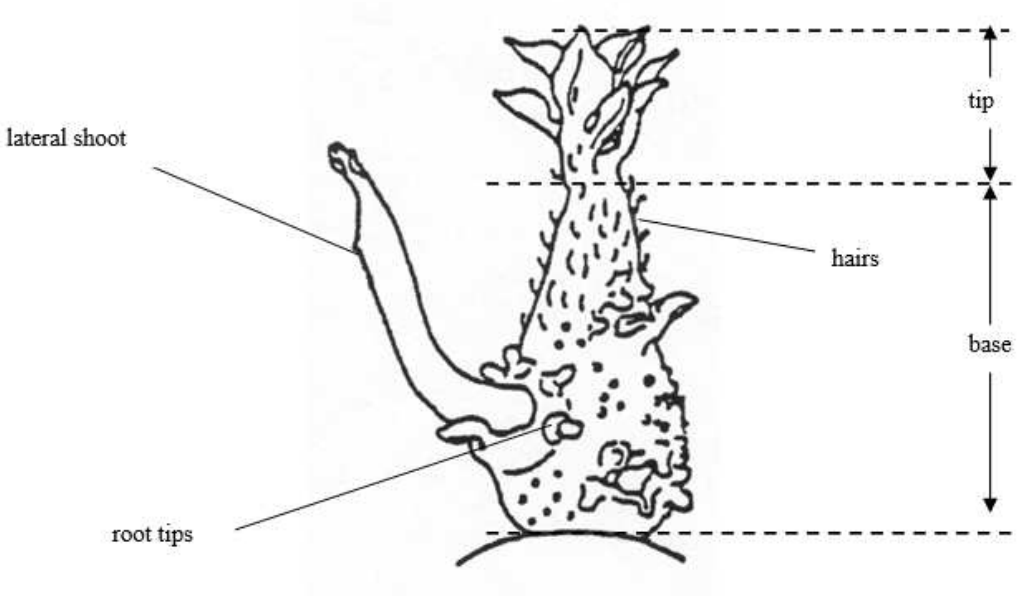
(d) Flower (Characteristics 27 – 29): All observations of flower colour should be made on the inner side of freshly opened flowers, the best moment is early in the morning.

(e) Tuber (Characteristics 32 – 37): All observations should be made within two weeks after harvest. Shield the tubers from sunlight as this may have an effect on the colour.

(f) Anthocyanin colouration (Characteristics 3, 8, 14, 19, 22, 25, 27): The intensity of the anthocyanin colouration should be observed. The extension and the distribution should not be considered.

8.2 Explanations for individual characteristics

Ad 1 - 11: Lightsprout



Ad. 2: Lightsprout: shape of base

1 spherical | 2 ovoid | 3 conical | 4 broad cylindrical | 5 narrow cylindrical

Ad. 4: Lightsprout: proportion of blue in anthocyanin colouration of base

The colour of anthocyanin results from a red and a blue component. If the proportion of blue is low the anthocyanin appears red-violet. If the proportion of blue is high the anthocyanin appears blue-violet.

Ad. 5: Lightsprout: pubescence of base

It is recommended to use a magnifier.

Pubescence is not always evenly distributed over the light sprout. The total amount of pubescence of the base should be averaged over the total area of the light sprout base.

Ad. 6: Lightsprout: size of tip in relation to base

The size of the tip should be examined in relation to the size of the base. The following table gives an indication between notes and ration between size of tip and base

note	ratio size tip : size base
1	10:90
2	20:80
3	30:70
4	40:60
5	50:50
6	60:40
7	70:30
8	80:20
9	90:10

Ad. 7: Lightsprout: habit of tip

1
closed

3
intermediate

5
open

Ad. 9: Lightsprout: pubescence of tip

It is recommended to use a magnifier.

Pubescence is not always evenly distributed over the light sprout. The total amount of pubescence of the tip should be averaged over the total area of the light sprout tip.

Ad. 11: Lightsprout: length of lateral shoots

1
closed

3
intermediate

5
open

Ad. 12: Plant: foliage structure

Stem type: foliage open, stems clearly visible
Intermediate type: foliage half open, stems partly visible
Leaf type: foliage closed, stems not, or hardly, visible

1
closed

3
intermediate

5
open

Ad. 13: Plant: growth habit

3
upright

5
semi-upright

7
spreading

Ad. 14: Stem: anthocyanin colouration

Intensity should be observed on the lower three quarter of the stems.

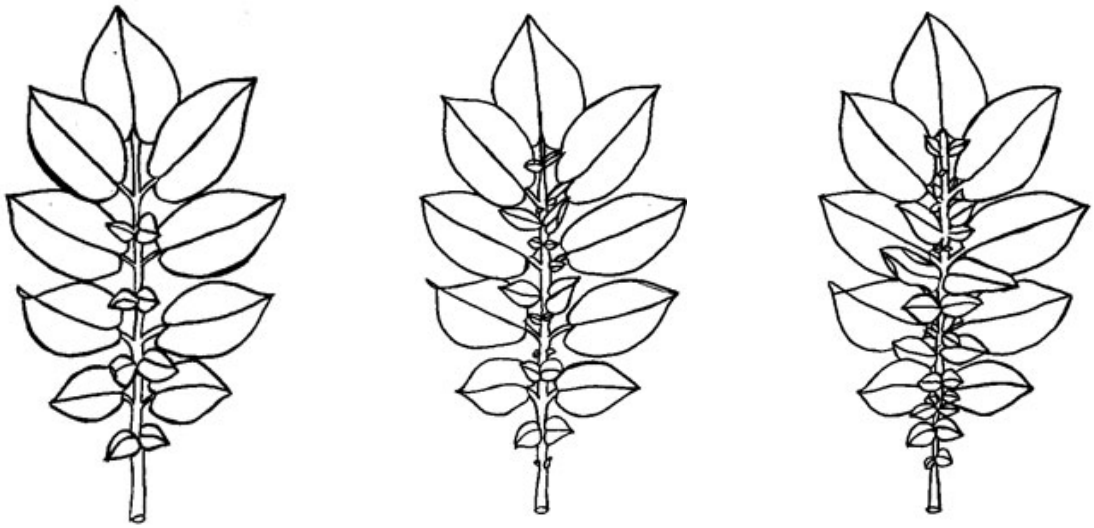
Ad. 16: Leaf: openness

1
closed

3
intermediate

5
open

Ad. 17: Leaf: presence of secondary leaflets



3
weak

5
medium

7
strong

Ad. 18: Leaf: green colour

Observations should be done when it is slightly clouded.

Ad. 20: Second pair of lateral leaflets: width in relation to length

3
weak

5
medium

7
strong

Ad. 21: Terminal and lateral leaflets: frequency of coalescence

not coalescent

coalescent

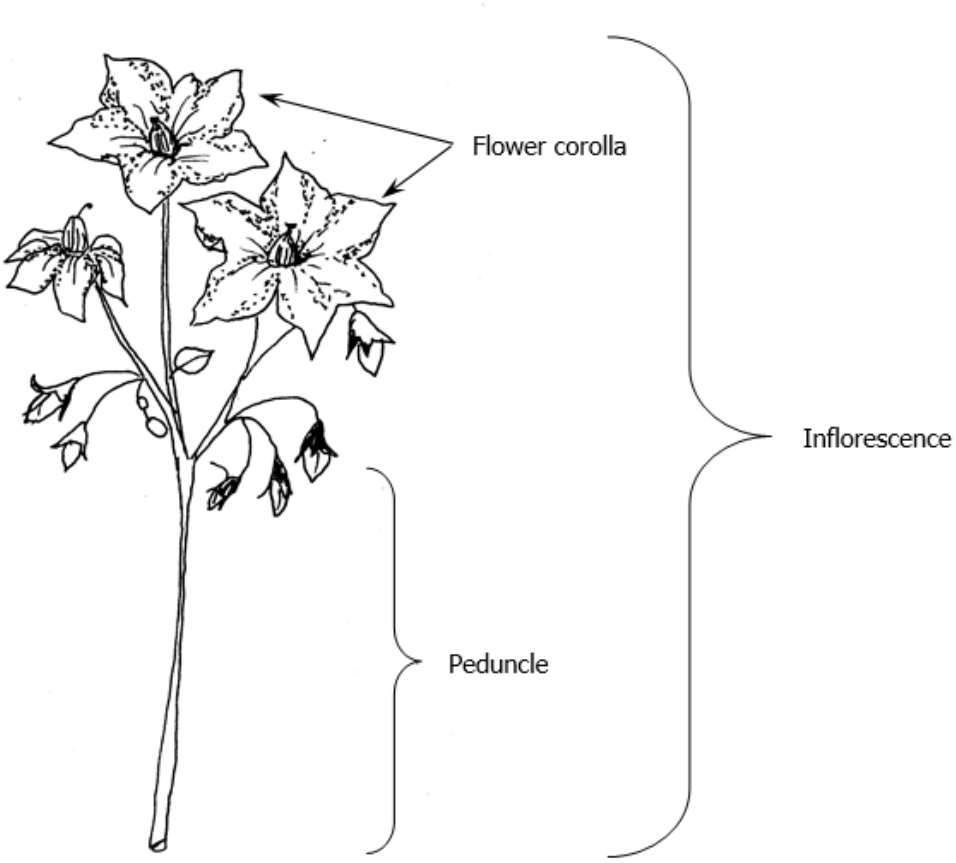
Ad. 22: Flower bud: anthocyanin colouration

The observations should be made on fully developed buds before the corolla is visible.

Ad. 23: Plant: frequency of inflorescences

During the flowering period the plots are observed several times and the frequency is scored. The highest score reached is noted as the final state of expression.

Ads. 24–29: Inflorescence and flower characteristics



Ad. 24: Inflorescence: size

The general impression of the whole plot is observed

Ad. 28: Flower corolla: proportion of blue in anthocyanin colouration on inner side

The colour of anthocyanin results from a red and a blue component. If the proportion of blue is low the anthocyanin appears red-violet. If the proportion of blue is high the anthocyanin appears blue-violet.

Ad. 31: Plant: time of maturity

Time of maturity is reached when 80% of the leaves are dead.

Ad. 32: Tuber: shape

The predominant shape should be observed

1	2	3	4	5	6
round	short-oval	oval	long-oval	long	very long

Ad. 36: Tuber: colour of eye

Not applicable for varieties with particoloured skin (note 7 an 9 in characteristic 34. Tuber: colour of skin)

Ad. 37: Tuber: colour of flesh

Observations should be made on freshly cut tubers. Already a few minutes after cutting the tuber, the flesh may be discoloured.

8.3 Phenological growth stages and BBCH-identification keys of potato (Meier et al., 1997)

CODE		DESCRIPTION	
		Description of development from tuber	**Description of development from seed**
2- and 3 digit			
Principal growth stage 0: Sprouting/Germination			
00	000	Innate or enforced dormancy, tuber not sprouted	Dry seed
01	001	Beginning of sprouting: sprouts visible (< 1 mm)	Beginning of seed imbibition
02	002	Sprouts upright (< 2 mm)	
03	003	End of dormancy: sprouts 2–3 mm	Seed imbibition complete
04	004	-	-
05	005	Beginning of root formation	Radicle (root) emerged from seed
06	006	-	-
07	007	Beginning of stem formation	Hypocotyl with cotyledons breaking through seed coat
08	008	Stems growing towards soil surface, formation of scale leaves in the axils of which stolons will develop later	Hypocotyl with cotyledons growing
09	009	Emergence: stems break through soil surface	Emergence: cotyledons break through soil surface

021-029[1]

[1] For second generation sprouts

CODE		DESCRIPTION
2- and 3 digit		
Principal growth stage 1: Leaf development		
10	100	From tuber: first leaves begin to extend. From seed: cotyledons completely unfolded.
11	101	1st leaf of main stem unfolded (> 4 cm)
12	102	2nd leaf of main stem unfolded (> 4 cm)
13	103	3rd leaf Auf main stem unfolded (> 4 cm)
1.	10.	Stages continuous till . . .
19	109	9 or more leaves of main stem unfolded (> 4cm) (2digit)[2]; 9 leaves of main stem unfolded (> 4 cm) (3digit)
-	110	10th leaf of main stem unfolded (> 4 cm)
-	11.	Stages continuous till . . .
-	119	19. leaf of main stem unfolded (> 4 cm)
-	121	First leaf of 3rd order branch above 2nd inflorescence unfolded (> 4 cm)
-	122	2nd leaf of 2nd order branch above first inflorescence unfolded (> 4 cm)
	12.	Stages continuous till . . .
	131	First leaf of 3rd order branch above 2nd inflorescence unfolded (> 4 cm)
-	132	2nd leaf of 3rd order branch above 2nd inflorescence unfolded (> 4 cm)
	13.	Stages continuous till . . .
	1NX	Xth leaf of nth order branch above n-1th inflorescence unfolded (> 4 cm)
Principal growth stage 2: Formation of basal side shoots below and above soil surface (main stem)		
21	201	First basal side shoot visible (> 5 cm)
22	202	2nd side shoot of first order visible
23	203	3rd side shoot of first order visible
2.	20.	Stages continuous till ...
29	209	9 or more basal side shoots visible (> 5 cm)
Principal growth stage 3: Main stem elongation (crop cover)		
31	301	Beginning of crop cover: 10% of plants meet between rows
32	302	20% off plants meet between rows
33	303	30% of plants meet between rows
34	304	40% of plants meet between rows
35	305	50% of plants meet between rows
36	306	60% of plants meet between rows
37	307	70% of plants meet between rows
38	308	80% of plants meet between rows

[2] Stem development stops after termination of main stem by an inflorescence. Branches arise from axils of upper leaves of the main stem, exhibiting a sympodial branching pattern

CODE		DESCRIPTION
2- and 3 digit		
39	309	Crop cover complete: about 90% of plants meet between rows
Principal growth stage 4: Tuber formation		
40	400	Tuber initiation: swelling of first stolon tips to twice the diameter of subtending stolon
41	401	10% of total final tuber mass reached
42	402	20% of total final tuber mass reached
43	403	30% of total final tuber mass reached
44	404	40% of total final tuber mass reached
45	405	50% of total final tuber mass reached
46	406	60% of total final tuber mass reached
47	407	70% of total final tuber mass reached
48	408	Maximum of total tuber mass reached, tubers detach easily from stolons, skin set not yet complete (skin easily removable with thumb)
49	409	Skin set complete: (skin at apical end of tuber not removable with thumb) 95% of tubers in this stage
Principal growth stage 5: Inflorescence (cyme) emergence		
51	501	First individual buds (1–2 mm) of first inflorescence visible (main stem)
55	505	Buds of first inflorescence extended to 5 mm
59	509	First flower petals of first inflorescence visible
	521	Individual buds of 2nd inflorescence visible (second order branch)
	525	Buds of 2nd inflorescence extended to 5 mm open (main stem)
	529	First flower petals of 2nd inflorescence visible above sepals
	531	Individual buds of 3rd inflorescence visible(3rd order branch)
	535	Buds of 3rd inflorescence extended to 5 mm
	539	First flower petals of 3rd inflorescence visible above sepals
	5N	Nth inflorescence emerging
Principal growth stage 6: Flowering		
60	600	First open flowers in population
61	601	Beginning of flowering about 10% of flowers in the first inflorescence open (main stem)
62	602	20% of flowers in the first inflorescence open
63	603	30% of flowers in the first inflorescence open
64	604	40% of flowers in the first inflorescence open
65	605	Full flowering: 50% of flowers in the first inflorescence open
66	606	60% of flowers in the first inflorescence open
67	607	70% of flowers in the first inflorescence open
68	608	80% of flowers in the first inflorescence open

CODE		DESCRIPTION
2- and 3 digit		
69	609	End of flowering in the first inflorescence
-	621	Beginning of flowering: 10% of flowers in the 2nd inflorescence open (second order branch)
-	625	Full flowering: 50% of flowers in the 2nd inflorescence open
-	629	End of flowering in the 2nd inflorescence
-	631	Beginning of flowering: 10% of flowers in the 3rd inflorescence open (third order branch)
-	635	Full flowering: 50% of flowers in the 3rd inflorescence open
-	639	End of flowering in the 3rd inflorescence
-	6N.	Nth inflorescence flowering
-	6N9	End of flowering
Principal growth stage 7: Development of fruit		
70	700	First berries visible
71	701	10% of berries in the first fructification have reached full size (main stem)
72	702	20% of berries in the first fructification have reached full size
73	703	30% of berries in the first fructification have reached full size
7.	70.	Stages continuous till . . .
	721	10% of berries in the 2nd fructification have reached full size (second order branch)
	7N.	Development of berries in nth fructification
	7N9	Nearly all berries in the nth fructification have reached full size (or have been shed)
Principal growth stage 8: Ripening of fruit and seed		
81	801	Berries in the first fructification still green, seed light-coloured (main stem)
85	805	Berries in the first fructification ochre-coloured or brownish
89	809	Berries in the first fructification shrivelled, seed dark
	821	Berries in the 2nd fructification still green, seed light-coloured (second order branch)
	8N.	Ripening of fruit and seed in nth fructification
Principal growth stage 9: Senescence		
91	901	Beginning of leaf yellowing
93	903	Most of the leaves yellowish
95	905	50% of the leaves brownish
97	907	Leaves and stem dead, stems bleached and dry
99	909	Harvested product

9. LITERATURE

Meier U., 1997: Growth stages of mono- and dicotyledonous plants: BBCH-Monograph. Blackwell Wissenschafts-Verlag, Berlin, Wien.

10. TECHNICAL QUESTIONNAIRE

The Technical Questionnaire is available on the CPVO website under the following reference: CPVO-TQ/023/3