



TG/76/9(proj.4)

ORIGINAL: English

DATE: 2022-01-07

INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS

Geneva

DRAFT

SWEET PEPPER, HOT PEPPER,
PAPRIKA, CHILI

UPOV Code(s): CAPSI_ANN

Capsicum annuum L.

GUIDELINES

FOR THE CONDUCT OF TESTS

FOR DISTINCTNESS, UNIFORMITY AND STABILITY

*prepared by an expert from the Netherlands
to be considered by the
Technical Working Party for Vegetables
at its fifty-sixth session, to be held virtually,
from 2022-04-18 to 2022-04-22*

Disclaimer: this document does not represent UPOV policies or guidance

Alternative names:*

Botanical name	English	French	German	Spanish
<i>Capsicum annuum</i> L.	Sweet Pepper, Hot Pepper, Paprika, Chili	Piment, Poivron	Paprika	Aji, Chile, Pimiento

The purpose of these guidelines ("Test Guidelines") is to elaborate the principles contained in the General Introduction (document TG/1/3), and its associated TGP documents, into detailed practical guidance for the harmonized examination of distinctness, uniformity and stability (DUS) and, in particular, to identify appropriate characteristics for the examination of DUS and production of harmonized variety descriptions.

ASSOCIATED DOCUMENTS

These Test Guidelines should be read in conjunction with the General Introduction and its associated TGP documents.

* These names were correct at the time of the introduction of these Test Guidelines but may be revised or updated. [Readers are advised to consult the UPOV Code, which can be found on the UPOV Website (www.upov.int), for the latest information.]

TABLE OF CONTENTS	PAGE
1. SUBJECT OF THESE TEST GUIDELINES.....	4
2. MATERIAL REQUIRED.....	4
3. METHOD OF EXAMINATION.....	4
3.1 Number of Growing Cycles.....	4
3.2 Testing Place.....	4
3.3 Conditions for Conducting the Examination.....	4
3.4 Test Design.....	5
3.5 Additional Tests.....	5
4. ASSESSMENT OF DISTINCTNESS, UNIFORMITY AND STABILITY.....	5
4.1 Distinctness.....	5
4.2 Uniformity.....	6
4.3 Stability.....	7
5. GROUPING OF VARIETIES AND ORGANIZATION OF THE GROWING TRIAL.....	8
6. INTRODUCTION TO THE TABLE OF CHARACTERISTICS.....	9
6.1 Categories of Characteristics.....	9
6.2 States of Expression and Corresponding Notes.....	9
6.3 Types of Expression.....	10
6.4 Example Varieties.....	10
6.5 Legend.....	11
7. TABLE OF CHARACTERISTICS/TABLEAU DES CARACTÈRES/MERKMALSTABELLE/TABLA DE CARACTERES.....	12
8. EXPLANATIONS ON THE TABLE OF CHARACTERISTICS.....	36
8.1 Explanations covering several characteristics.....	36
8.2 Explanations for individual characteristics.....	37
9. LITERATURE.....	63
10 TECHNICAL QUESTIONNAIRE.....	64

1. Subject of these Test Guidelines

1.1 These Test Guidelines apply to all varieties of *Capsicum annuum* L. including rootstocks and ornamentals.

1.2 In the case of ornamental and rootstock varieties, in particular, it may be necessary to use additional characteristics or additional states of expression to those included in the Table of Characteristics in order to examine Distinctness, Uniformity and Stability.

2. Material Required

2.1 The competent authorities decide on the quantity and quality of the plant material required for testing the variety and when and where it is to be delivered. Applicants submitting material from a State other than that in which the testing takes place must ensure that all customs formalities and phytosanitary requirements are complied with.

2.2 The material is to be supplied in the form of seed or plants.

2.3 The minimum quantity of plant material, to be supplied by the applicant, should be:

(a) seed propagated varieties: 2,500 seeds

(b) vegetatively propagated varieties: 25 non grafted young plants without fruits, with at least 2 growing points per plant. For disease resistance testing, additional plants may be requested.

In the case of seed, the seed should meet the minimum requirements for germination, species and analytical purity, health and moisture content, specified by the competent authority.

2.4 The plant material supplied should be visibly healthy, not lacking in vigor, nor affected by any important pest or disease.

2.5 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.

3. Method of Examination

3.1 *Number of Growing Cycles*

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

3.1.2 The two independent growing cycles should be in the form of two separate plantings.

3.1.3 The testing of a variety may be concluded when the competent authority can determine with certainty the outcome of the test.

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".

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.

3.4 *Test Design*

- 3.4.1 Each test should be designed to result in a total of at least 20 plants which should be divided between at least 2 replicates.
- 3.4.2 The design of the tests should be such that plants or parts of plants may be removed for measurement or counting without prejudice to the observations which must be made up to the end of the growing cycle.
- 3.4.3 When resistance characteristics are used for assessing distinctness, uniformity and stability, records must be taken under conditions of controlled infection and, unless otherwise specified, on at least 20 plants.

In the case of vegetatively propagated varieties, when resistance characteristics are used for assessing distinctness, uniformity and stability, records must be taken on at least 10 plants.

3.5 *Additional Tests*

Additional tests, for examining relevant characteristics, may be established.

4. Assessment of Distinctness, Uniformity and Stability

4.1 *Distinctness*

4.1.1 General Recommendations

It is of particular importance for users of these Test Guidelines to consult the General Introduction prior to making decisions regarding distinctness. However, the following points are provided for elaboration or emphasis in these Test Guidelines.

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 Test Guidelines are familiar with the recommendations contained in the General Introduction prior to making decisions regarding distinctness.

4.1.4 Number of Plants or Parts of Plants to be Examined

Unless otherwise indicated, for the purposes of distinctness, all observations on single plants should be made on 10 plants or parts of plants taken from each of 10 plants and any other observations 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 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

MS: measurement of a number of individual plants or parts of plants

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

VS: visual assessment by observation of individual 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. color 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

- 4.2.1 It is of particular importance for users of these Test Guidelines to consult the General Introduction prior to making decisions regarding uniformity. However, the following points are provided for elaboration or emphasis in these Test Guidelines:
- 4.2.2 These Test Guidelines have been developed for the examination of seed-propagated varieties and vegetatively propagated varieties. For varieties with other types of propagation, the recommendations in the General Introduction and document TGP/13 "Guidance for new types and species" Section 4.5 "Testing Uniformity" should be followed.
- 4.2.3 The assessment of uniformity for open-pollinated varieties should be according to the recommendations for cross-pollinated varieties in the General Introduction.
- 4.2.4 For the assessment of uniformity of cross-pollinated varieties, a population standard of 2% and an acceptance probability of at least 95% should be applied. In the case of a sample size of 20 plants, 2 off-types are allowed.
- 4.2.5 For the assessment of uniformity of self pollinated varieties, hybrids and vegetatively propagated varieties, a population standard of 1% and an acceptance probability of at least 95% should be applied. In the case of a sample size of 20 plants, 1 off-type is allowed.

4.3 *Stability*

- 4.3.1 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.
- 4.3.2 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) Plant: shortened internodes (characteristic 4)
 - (b) Only for ornamental varieties: Leaf blade: intensity of anthocyanin coloration of upper side (characteristic 14)
 - (c) Only for ornamental varieties: Leaf blade: distribution of anthocyanin coloration of lower side (characteristic 15)
 - (d) Only for ornamental varieties: Leaf blade: variegation (characteristic 16)
 - (e) Flower: anthocyanin coloration of anther (characteristic 23)
 - (f) Immature fruit: color (characteristic 26)
 - (g) Fruit: length (characteristic 30)
 - (h) Fruit: diameter (characteristic 31)
 - (i) Fruit: ratio length/diameter (characteristic 32)
 - (j) Fruit: shape in longitudinal section (characteristic 33)
 - (k) Fruit: color (characteristic 41)
 - (l) Fruit: capsaicin in placenta (characteristic 48)
 - (m) Only for vegetable and rootstock varieties: Resistance to Tobamovirus - *Tobacco mosaic virus* - Group 0 (TMV: 0) (characteristic 54)
 - (n) Only for vegetable and rootstock varieties: Resistance to Tobamovirus - *Pepper mild mottle virus* - Group 2 (PMMoV: 1.2) (characteristic 55)
 - (o) Only for vegetable and rootstock varieties: Resistance to Tobamovirus - *Pepper mild mottle virus* - Group 3 (PMMoV: 1.2.3) (characteristic 56)
 - (p) Only for vegetable and rootstock varieties: Resistance to *Potato Y virus* (PVY) - Pathotype 0 (PVY: 0) (characteristic 57)
 - (q) Only for vegetable and rootstock varieties: Resistance to *Tomato spotted wilt virus* Pathotype 0 (TSWV: 0) (characteristic 62)

An explanation on vegetable, rootstock and ornamental types of varieties is given in chapter 8.3.

- 5.4 Guidance for the use of grouping characteristics, in the process of examining distinctness, is provided through the General Introduction and document TGP/9 "Examining Distinctness".

6. Introduction to the Table of Characteristics

6.1 *Categories of Characteristics*

6.1.1 Standard Test Guidelines Characteristics

Standard Test Guidelines characteristics are those which are approved by UPOV for examination of DUS and from which members of the Union can select those suitable for their particular circumstances.

6.1.2 Asterisked Characteristics

Asterisked characteristics (denoted by *) are those included in the Test Guidelines which are important for the international harmonization of variety descriptions and should always be examined for DUS and included in the variety description by all members of the Union, except when the state of expression of a preceding characteristic or regional environmental conditions render this inappropriate.

6.2 *States of Expression and Corresponding Notes*

6.2.1 States of expression are given for each characteristic to define the characteristic and to harmonize descriptions. Each state of expression is allocated a corresponding numerical note for ease of recording of data and for the production and exchange of the description.

6.2.2 All relevant states of expression are presented in the characteristic.

6.2.3 Further explanation of the presentation of states of expression and notes is provided in document TGP/7 "Development of Test Guidelines".

6.3 *Types of Expression*

An explanation of the types of expression of characteristics (qualitative, quantitative and pseudo-qualitative) is provided in the General Introduction.

6.4 *Example Varieties*

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

6.5 Legend

English				français		deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
1	2	3	4	5	6	7			
		Name of characteristics in English		Nom du caractère en français		Name des Merkmals auf Deutsch		Nombre del carácter en español	
		states of expression		types d'expression		Ausprägungsstufen		tipos de expresión	

- | | | | |
|---|---|---|---------------------|
| 1 | Characteristic number | | |
| 2 | (*) | Asterisked characteristic | – see Chapter 6.1.2 |
| 3 | Type of expression | | |
| | QL | Qualitative characteristic | – see Chapter 6.3 |
| | QN | Quantitative characteristic | – see Chapter 6.3 |
| | PQ | Pseudo-qualitative characteristic | – see Chapter 6.3 |
| 4 | Method of observation (and type of plot, if applicable) | | |
| | MG, MS, VG, VS | | – see Chapter 4.1.5 |
| 5 | (+) | See Explanations on the Table of Characteristics in Chapter 8.2 | |
| 6 | (a)-(c) | See Explanations on the Table of Characteristics in Chapter 8.1 | |
| 7 | Not applicable | | |

7. Table of Characteristics/Tableau des caractères/Merkmalstabelle/Tabla de caracteres

	English		français		deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
1.	QL	VG						
	Seedling: anthocyanin coloration of hypocotyl							
	absent						Albaregia	1
	present						Lamuyo	9
2.	QN	VG	(+)	(a)				
	Plant: habit							
	upright						De Cayenne, Doux très long des Landes, Piquant d'Algérie	1
	semi-upright						Sonar	2
	prostrate							3
3. (*)	QN	MG/MS/VG	(+)	(a)				
	Plant: height							
	very short							1
	very short to short							2
	short						Bravia	3
	short to medium							4
	medium						HRF	5
	medium to tall							6
	tall						Century	7
	tall to very tall							8
	very tall						Brutus	9
4. (*)	QL	VG	(+)	(a)				
	Plant: shortened internodes							
	absent						California wonder, De Cayenne	1
	present						Bucano	9

	English		français		deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
5.	PQ	MS	(+)	(a)				
	<u>Only varieties with plant: shortened internodes: present:</u> number of internodes between the first flower and shortened internodes							
	none							1
	one to three							2
	more than three							3
6.	QN	MS/VG		(a)				
	<u>Only varieties with plant: shortened internodes: absent:</u> length of internodes							
	very short						Albaregia	1
	short to very short							2
	short						Tenor	3
	short to medium							4
	medium						Florian	5
	medium to long							6
	long						Corno di toro rosso	7
	long to very long							8
	very long						Fenice	9
7.	QN	MS/VG	(+)	(a)				
	Stem: length							
	very short							1
	very short to short							2
	short						Bomenta, Corvinus	3
	short to medium							4
	medium						Bravia, Lamuyo, Nestoss, Remus	5
	medium to long							6
	long						Lipari, Marconi	7
	long to very long							8
	very long							9

	English		français	deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
8.	QN	VG	(a)				
	Stem: intensity of anthocyanin coloration of nodes						
	absent or very weak					Bravia, Nestoss, Remus	1
	very weak to weak						2
	weak					California wonder	3
	weak to medium						4
	medium					Lamuyo, Sonar	5
	medium to strong						6
	strong					Piquant d'Algérie	7
	strong to very strong						8
	very strong					Smolder	9
9.	QN	VG	(a)				
	Stem: hairiness of nodes						
	absent or very weak					Arlequin	1
	very weak to weak						2
	weak					Bravia, Nestoss	3
	weak to medium						4
	medium					Doux très long des Landes, Farnese	5
	medium to strong						6
	strong					Fenice, Solario	7
	strong very strong						8
	very strong					Brutus	9
10	QN	MS/VG	(a)				
	Leaf blade: length						
	very short					Macska sarga	1
	very short to short						2
	short					De Cayenne	3
	short to medium						4
	medium					Marconi	5
	medium to long						6
	long					Allrounder	7
	long to very long						8
	very long					Solario	9

	English		français	deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
11	QN	MS/VG	(a)				
	Leaf blade: width						
	very narrow					Macska sárga	1
	very narrow to narrow						2
	narrow					De Cayenne	3
	narrow to medium						4
	medium					Marconi	5
	medium to broad						6
	broad					Allrounder	7
	broad to very broad						8
	very broad					Solario	9
12	PQ	VG	(+)	(a)			
	Leaf blade: shape						
	lanceolate					Brutus, De Cayenne	1
	ovate					Balico, Sonar	2
	broad elliptic					Solario	3
13	QN	VG	(a)				
	Leaf blade: intensity of green color						
	very light						1
	very light to light						2
	light					Blondy	3
	light to medium						4
	medium					Allrounder, Frazier	5
	medium to dark						6
	dark					Rioverde	7
	dark to very dark						8
	very dark					Japo, Morrón de conserva 3, Roial	9

	English		français		deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
14 (*)	QN	VG	(+)	(a)				
	<u>Only for ornamental varieties:</u> Leaf blade: intensity of anthocyanin coloration of upper side							
	absent or very weak							1
	weak						Omiyamurasaki (O), Purple Rain (O)	2
	medium		faible		schwach	baja	Calico (O)	3
	strong						Black Pearl (O)	4
	very strong		moyenne		mittel	media	Purple Flash (O), Takiama Purple to Red (O), TF802 (o)	5
15 (*)	QN	VG	(+)	(a)				
	<u>Only for ornamental varieties:</u> Leaf blade: distribution of anthocyanin coloration of lower side							
	absent							1
	on veins throughout						Takiama Purple to Red (O)	2
	on veins and diffuse on distal part							3
	on veins and diffuse throughout						Black Pearl (O), Purple Flash (O)	4
	throughout						TF802 (o)	5
16 (*)	QL	VG	(+)	(a)				
	<u>Only for ornamental varieties:</u> Leaf blade: variegation							
	absent		absente		fehlend	ausente	Omiyamurasaki (O)	1
	present		présente		vorhanden	presente	Calico (O), Purple Rain (O)	9

	English		français	deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
17	QN	VG	(a)				
	Leaf blade: undulation of margin						
	absent or very weak					De Cayenne	1
	very weak to weak						2
	weak					Doux très long des Landes	3
	weak to medium						4
	medium					Tenor	5
	medium to strong						6
	strong					Tosca	7
	strong to very strong						8
	very strong						9
18	QN	VG	(a)				
	Leaf blade: blistering						
	very weak					Brutus	1
	very weak to weak						2
	weak					Pusztagold	3
	weak to medium						4
	medium					Bravia, Nestoss	5
	medium to strong						6
	strong					Greygo	7
	strong to very strong						8
	very strong					Florian	9
19	QN	VG	(a)				
	Leaf blade: glossiness						
	very weak						1
	very weak to weak						2
	weak					Brutus, Doux très long des Landes	3
	weak to medium						4
	medium					Bravia	5
	medium to strong						6
	strong					Floridor	7
	strong to very strong						8
	very strong						9

	English		français	deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
20	QN	VG	(+)				
	Time of beginning of flowering						
	very early						1
	very early to early						2
	early					Brutus	3
	early to medium						4
	medium					Allrounder, Lamuyo	5
	medium to late						6
	late					Piquant d'Algérie	7
	late to very late						8
	very late						9
21	PQ	VG	(+)				
	Flower: attitude of peduncle						
	predominantly erect					Floridor	1
	predominantly semi-drooping					Bravia	2
	predominantly drooping					Brutus, Lamuyo	3
22	PQ	VG					
	Flower: color						
	white					Lamuyo	1
	light purple						2
	medium purple						3
	dark purple					Black Pearl (O)	4
23 (*)	QL	VG	(+)				
	Flower: anthocyanin coloration of anther						
	absent					Bravia	1
	present					Brutus, Lamuyo	9
24	QL	VG	(+)				
	Flower: anthocyanin coloration of filament						
	absent					AG33	1
	present					Bao-11, Morningput	9

	English		français	deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
25	QN	VS	(+)				
	Male sterility						
	absent					California wonder	1
	partially present						2
	totally present					Angelito	3
26 (*)	PQ	VG	(b)				
	Immature fruit: color						
	greenish white					Bravia	1
	greenish yellow					Don, Sweet banana	2
	green					Allrounder, Black Bullet, Cornus, Hitman, Impala, Syrto	3
	purple					Cardinal, Lilo, Loco, Tequila, Tonaya	4
27 (*)	QN	VG	(b)				
	<u>Only varieties with immature fruit: color green or purple: intensity of color</u>						
	very light						1
	very light to light						2
	light					Cornus, Loco, Syrto	3
	light to medium					Tequila	4
	medium					Allrounder	5
	medium to dark					Cardinal	6
	dark					Impala, Lilo, Tonaya	7
	dark to very dark						8
	very dark					Black Bullet, Hitman	9
28	QN	VG	(b)				
	<u>Excluding varieties with immature fruit color: purple: Immature fruit: anthocyanin coloration</u>						
	absent or weak					Lamuyo	1
	medium						2
	strong					Sweet banana	3

	English		français	deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
29	PQ	VG	(c)				
	Fruit: attitude						
	erect					Pusztagold	1
	horizontal					PAZ szentesi	2
	drooping					De Cayenne, Lamuyo	3
30 (*)	QN	MS/VG	(+)	(c)			
	Fruit: length						
	very short					Cherry Bomb, PAZ szentesi	1
	very short to short						2
	short					Ophelia, Smolder	3
	short to medium						4
	medium					California wonder	5
	medium to long						6
	long					Bravia, De Cayenne	7
	long to very long						8
	very long					Carboni, Corno di toro rosso, Doux très long des Landes	9
31 (*)	QN	MS/VG	(+)	(c)			
	Fruit: diameter						
	very narrow					De Cayenne	1
	very narrow to narrow						2
	narrow					Cherry Bomb	3
	narrow to medium						4
	medium					Doux italien	5
	medium to broad						6
	broad					Lamuyo, Maduro	7
	broad to very broad						8
	very broad					Floridor, Ibleor	9

	English		français		deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
32	(*)	QN	MS/VG	(+)	(c)			
	Fruit: ratio length/diameter							
	very low						Liebesapfel, PAZ szentesi	1
	very low to low							2
	low						Bucano	3
	low to medium							4
	medium						Maduro	5
	medium to high							6
	high						Lamuyo, Vidi	7
	high to very high							8
	very high						De Cayenne, Doux très long des Landes	9
33	(*)	PQ	VG	(+)	(c)			
	Fruit: shape in longitudinal section							
	rectangular						Raggio	1
	square						Maranello	2
	transverse rectangular						Liebesapfel, PAZ szentesi	3
	elliptic							4
	circular						Capperino	5
	oblate						Koral	6
	trapezoid						Altea	7
	triangular						Bravia, Corno di toro rosso, De Cayenne	8
	cordate						Morrón de conserva 3	9
	ovate						Jalapeño	10
34		PQ	VG	(+)	(c)			
	Fruit: curvature							
	absent						Kappy, Lamuyo	1
	predominantly C-shaped						Sweet banana	2
	predominantly S-shaped						Doux italien	3
35		QN	VG	(+)	(c)			
	Fruit: twisting							
	absent or weak						California wonder	1
	medium						Bubión	2
	strong						BN8707	3

	English		français		deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
36	PQ	VG	(+)	(c)				
	Fruit: shape in cross section							
	elliptic						Sweet banana	1
	angular						Solario	2
	circular						Doux très long des Landes	3
37	QN	VG	(+)	(c)				
	Fruit: sinuation of pericarp at basal part							
	absent or very weak						Smolder	1
	very weak to weak							2
	weak						Donat, Kappy	3
	weak to medium							4
	medium						Banán	5
	medium to strong							6
	strong						Hawker	7
	strong to very strong							8
	very strong						Doux italien, Gelber Spiral	9
38 (*)	QN	VG	(+)	(c)				
	Fruit: sinuation of pericarp excluding basal part							
	absent or weak						Sonar, Yolo Wonder	1
	medium						Rodri	2
	strong						De Cayenne, Doux italien	3
39 (*)	PQ	VG		(c)				
	Fruit: shape of apex							
	very acute						De Cayenne	1
	moderately acute						Kappone	2
	rounded						Red Tinkerbelle	3
	moderately depressed						Maduro	4
	very depressed						Monte	5

	English		français		deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
40	QN	VG	(+)	(c)				
	Fruit: texture of surface							
	smooth or very slightly wrinkled						Smolder	1
	slightly wrinkled							2
	strongly wrinkled							3
41 (*)	PQ	VG	(+)	(c)				
	Fruit: color							
	yellow						Allrounder	1
	orange						Ariane	2
	red						Lamuyo	3
	brown						Chocolony	4
	green							5
42 (*)	QN	VG	(+)	(c)				
	Fruit: intensity of color							
	very light							1
	very light to light							2
	light							3
	light to medium							4
	medium							5
	medium to dark							6
	dark							7
	dark to very dark							8
	very dark							9

	English		français	deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
43	QN	VG	(c)				
	Fruit: glossiness						
	very weak						1
	very weak to weak						2
	weak					Macska sárga	3
	weak to medium						4
	medium					Sonar	5
	medium to strong						6
	strong					Doux italien	7
	strong to very strong						8
	very strong					Ocelot	9
44 (*)	QN	VG	(c)				
	Fruit: depth of peduncle cavity						
	absent or very shallow					Sweet banana	1
	very shallow to shallow						2
	shallow					Doux italien	3
	shallow to medium						4
	medium					Lamuyo, Maduro	5
	medium to deep						6
	deep					Baquero	7
	deep to very deep						8
	very deep					Dumbo34	9
45	QN	VG	(+)	(c)			
	Fruit: depth of interocular grooves						
	absent or very shallow					De Cayenne	1
	very shallow to shallow						2
	shallow					Kappone	3
	shallow to medium						4
	medium					Lamuyo, Marconi	5
	medium to deep						6
	deep					Round of Hungary	7
	deep to very deep						8
	very deep						9

	English		français	deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
46 (*)	QN	MG/VG	(c)				
	Fruit: number of locules						
	predominantly two					De Cayenne	1
	equally two and three					Banán	2
	predominantly three					Century	3
	equally three and four					Lamuyo, Sonar	4
	predominantly four					PAZ szentesi	5
47 (*)	QN	VG	(c)				
	Fruit: thickness of flesh						
	very thin					De Cayenne, Macska sárga	1
	very thin to thin						2
	thin					Banán, Doux très long des Landes	3
	thin to medium						4
	medium					Lamuyo	5
	medium to thick						6
	thick					Deimos	7
	thick to very thick						8
	very thick					Solario	9
48 (*)	QL	VG	(+)	(c)			
	Fruit: capsaicin in placenta						
	absent					Sonar, Sweet banana	1
	present					De Cayenne	9
49	QL	VG	(+)	(c)			
	Fruit: seeds						
	absent					Angelito	1
	present					Lamuyo	9

	English		français		deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
50	QN	MS/VG	(c)					
	Peduncle: length							
	very short						Jablina	1
	very short to short							2
	short						Corvinus, Yolo Wonder	3
	short to medium							4
	medium						Sonar	5
	medium to long							6
	long						De Cayenne	7
	long to very long							8
	very long						Farnese, Lipari	9
51	QN	MS/VG	(+)	(c)				
	Peduncle: thickness							
	very thin						De Cayenne, Doux très long des Landes, Macska sárga	1
	very thin to thin							2
	thin						Sweet banana	3
	thin to medium							4
	medium						Doux italien	5
	medium to thick							6
	thick						Lamuyo	7
	thick to very thick							8
	very thick							9
52	QN	VG	(+)	(c)				
	Calyx: aspect							
	non enveloping						Lamuyo, Sonar	1
	semi enveloping							2
	enveloping						De Cayenne, Sweet banana	3

	English		français	deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
53 (*)	QN	VG	(+)				
	Time of maturity						
	very early					Macska sárga, Madison	1
	early					Kosmik	3
	early to medium						4
	medium					Lamuyo, Sonar	5
	medium to late						6
	late					Doux d'Espagne	7
	late to very late						8
	very late					Teseo	9
54 (*)	QL	VG	(+)				
	<u>Only for vegetable and rootstock varieties:</u> Resistance to Tobamovirus - Tobacco mosaic virus - Group 0 (TMV: 0)						
	absent					Lamu, Pepita, Piquillo	1
	present					Fehérözön, Turia, Ultron, Yolo Wonder	9
55 (*)	QL	VG	(+)				
	<u>Only for vegetable and rootstock varieties:</u> Resistance to Tobamovirus - Pepper mild mottle virus - Group 2 (PMMoV: 1.2)						
	absent					Fehérözön, Lamu, Turia, Yolo Wonder	1
	present					Achille, Candela, Ferrari, Fudji, Novi 3, PI 15225	9
56 (*)	QL	VG	(+)				
	<u>Only for vegetable and rootstock varieties:</u> Resistance to Tobamovirus - Pepper mild mottle virus - Group 3 (PMMoV: 1.2.3)						
	absent					Candela, Ferrari, Oida, Yolo Wonder	1
	present					Bisonte, Ettore, Friendly, Tom4	9

	English		français	deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
57 (*)	QL	VG	(+)				
	<u>Only for vegetable and rootstock varieties:</u> Resistance to <i>Potato Y virus</i> (PVY) - Pathotype 0 (PVY: 0)						
	absent					Ferrari, Murillo, Piquillo, Yolo Wonder	1
	present					Andalus, Goleador, Vidi, Yolo Y	9
58	QL	VG	(+)				
	<u>Only for vegetable and rootstock varieties:</u> Resistance to <i>Potato Y virus</i> (PVY) - Pathotype 1 (PVY: 1)						
	absent					Yolo Wonder, Yolo Y	1
	present					Florida VR2, Ribatejo	9
59	QL	VG	(+)				
	<u>Only for vegetable and rootstock varieties:</u> Resistance to <i>Potato Y virus</i> (PVY) - Pathotype 1.2 (PVY: 1.2)						
	absent					Florida VR2, Yolo Wonder, Yolo Y	1
	present					Chouca, Serrano Criollo de Morelos 334	9
60	QL	VG	(+)				
	<u>Only for vegetable and rootstock varieties:</u> Resistance to <i>Phytophthora capsici</i> (Pc)						
	absent					Yolo Wonder	1
	present					Chistera, Favolor, Phyo 636, Solario	9
61	QL	VG	(+)				
	<u>Only for vegetable and rootstock varieties:</u> Resistance to <i>Cucumber mosaic virus</i> (CMV)						
	absent					Yolo Wonder	1
	present					Alby, Favolor	9

	English		français	deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
62 (*)	QL	VG	(+)				
	<u>Only for vegetable and rootstock varieties:</u> Resistance to <i>Tomato spotted wilt virus</i> Pathotype 0 (TSWV: 0)						
	absent					Yolo Wonder	1
	present					Galileo, Jackal, Jackpot, Piamonte	9
63	QL	VG	(+)				
	<u>Only for vegetable and rootstock varieties:</u> Resistance to <i>Xanthomonas campestris</i> pv. <i>vesicatoria</i> (now <i>Xanthomonas</i> ssp) / 2026 (Xcv) (now X spp) - Pathotype 1						
	absent					Yolo Wonder	1
	present					Filidor, San Marco	9
64	QL	VG	(+)				
	<u>Only for vegetable and rootstock varieties:</u> Resistance to <i>Xanthomonas campestris</i> pv. <i>vesicatoria</i> ((now <i>Xanthomonas</i> ssp) / 2026 (Xcv) (now X spp) - Pathotype 2						
	absent					Yolo Wonder	1
	present					Filidor, San Marco	9
65	QL	VG	(+)				
	<u>Only for vegetable and rootstock varieties:</u> Resistance to <i>Xanthomonas campestris</i> pv. <i>vesicatoria</i> (now <i>Xanthomonas</i> ssp) / 2026 (Xcv) (now X spp) - Pathotype 3						
	absent					Yolo Wonder	1
	present					Filidor, San Marco	9

	English		français	deutsch	español	Example Varieties Exemples Beispielssorten Variedades ejemplo	Note/ Nota
66	QL	MS/VG	(+)				
	<u>Only for vegetable and rootstock varieties:</u> Resistance to <i>Meloidogyne incognita</i>						
	absent					Tom4, Yolo Wonder	1
	present					Bastion, Capital, Kation, W4	9

8. Explanations on the Table of Characteristics

8.1 *Explanations covering several characteristics*

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

- (a) Observations on plant, stem, internodes and leaves should be made at the time of the first color change of the fruit. Furthermore observations on stem and leaves should be made at the middle third of the plant.
- (b) Observations should be made before the first color change of the fruit.
- (c) Observations should be made at maturity, after the time of the color change.

8.2 *Explanations for individual characteristics*

Ad. 2: Plant: habit

Observations only to be made when plants do not have prominent influence of pruning, guiding or stakes on their natural habit.

Ad. 3: Plant: height

Observations to be made after a fruit set on several nodes. Poor fruit set may influence the vigor and thus the height of the plant.

Ad. 4: Plant: shortened internodes



1
absent



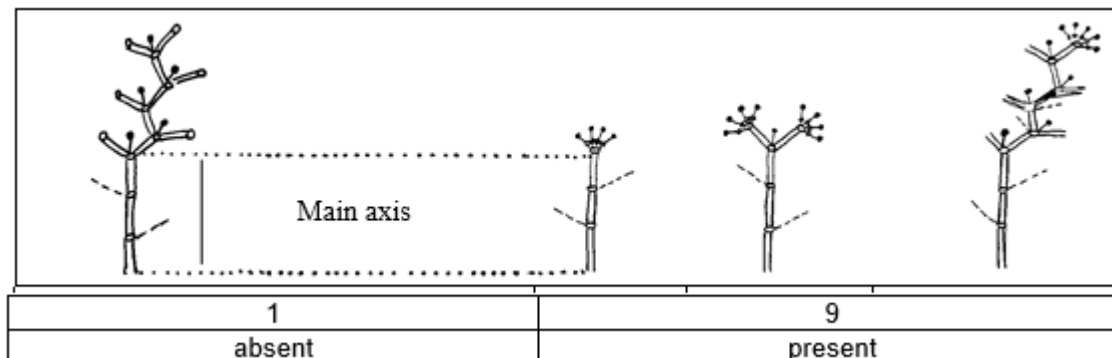
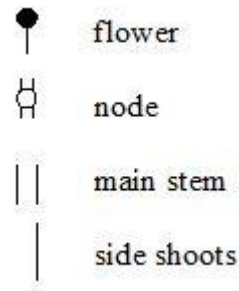
9
present

Observations should be made on plants which have not been pruned, in the upper part. The shoot system of pepper consists of main stems developing from the main axis, and side shoots which develop from the nodes on the main axis and on the main stems.

Absent: the main stems grow indeterminately; one or two flowers develop per node and shortened internodes never develop.

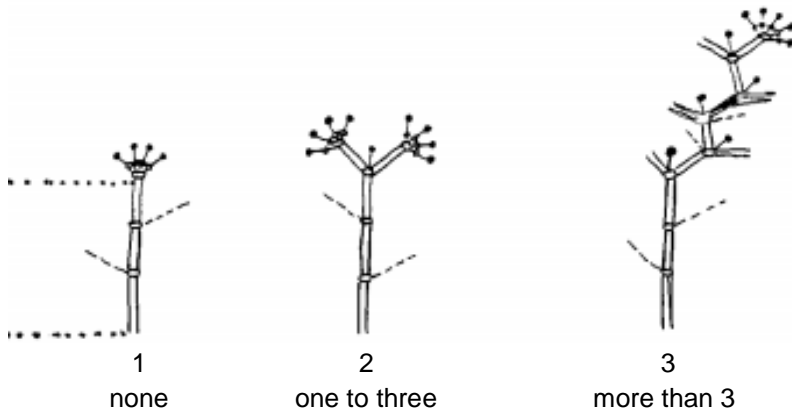
Observations on the length of internodes of varieties with shortened internodes absent should be made on primary side shoots.

Present: after the first branching of the main axis, shorter internodes appear and the growth of the main stem ends in a bunch of flowers (it appears as if there are more than two flowers per node).



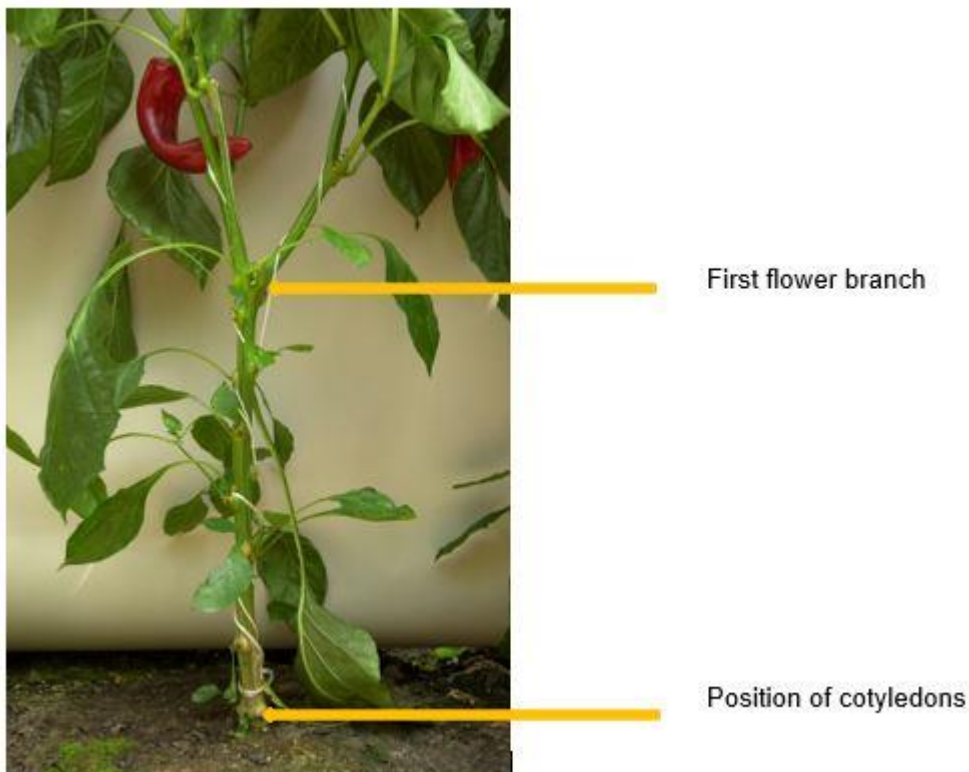
Ad. 5: Only varieties with plant: shortened internodes: present: number of internodes between the first flower and shortened internodes

See Ad 4. for explanation of schematic plant parts



Ad. 7: Stem: length

Observations should be made from the cotyledons to the node of the first flower branch.



Ad. 12: Leaf blade: shape



1
lanceolate



2
ovate



3
broad elliptic

Ad. 14: Only for ornamental varieties: Leaf blade: intensity of anthocyanin coloration of upper side

Observations should be made on leaves when they are just fully developed.

Ad. 15: Only for ornamental varieties: Leaf blade: distribution of anthocyanin coloration of lower side

See Ad. 14



2
on veins throughout



3
on veins and diffuse on
distal part



4
on veins and diffuse
throughout



5
throughout

Ad. 16: Only for ornamental varieties: Leaf blade: variegation

See Ad.14

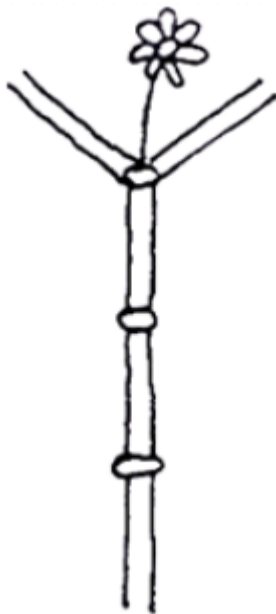


9
present

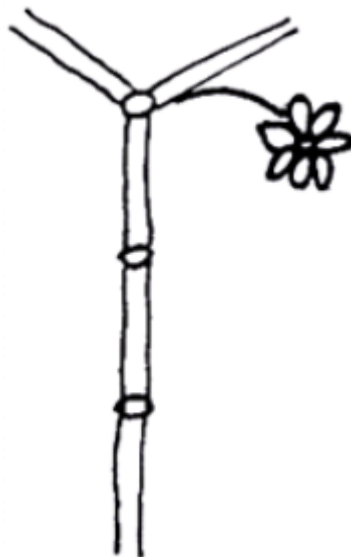
Ad. 20: Time of beginning of flowering

Observations should be made at the first flower on the second flowering node.

Ad. 21: Flower: attitude of peduncle



1
predominantly erect



2
predominantly semi-drooping



3
predominantly drooping

Ad. 23: Flower: anthocyanin coloration of anther

Observations should be made on the part of the stamen that produces pollen, i.e. the anther.



1
absent



9
present

Ad. 24: Flower: anthocyanin coloration of filament

Observations should be made on the stalk of the stamen, i.e. the filament.



1
absent



9
present

Ad. 25: Male sterility

Observations should be made on the anthers at full flowering. Male sterile flowers do not have pollen.

Partial sterility

A partially male sterile variety (a parent line) consists of 50% plants with male sterile flowers and 50% of plants with male fertile flowers. This segregation (ref. TG/1/3 and TGP/10 section 2.4) is a result of the method of propagation of the variety. The heredity of this segregation is known, and behaves in the predicted manner.

Selfing and maintenance of a the variety (parent line)

gg (gms, male sterile) x GG (normal germplasm, male fertile) results in gG.

After selfing the offspring will be 50% gG, 25% gg and 25% GG.

For a higher rate of steriles and the maintenance of the line the cross gg x gG is made. This results in 50% sterile and 50% fertile.



1
absent



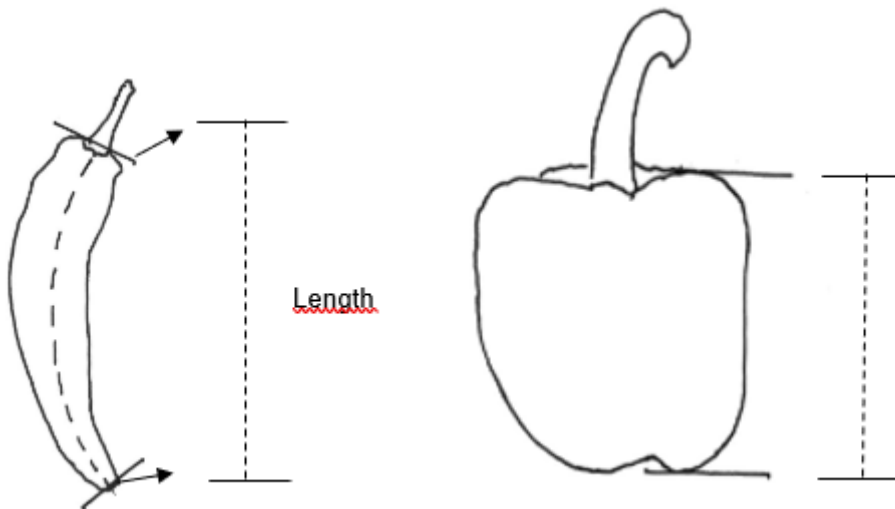
3
present

Ad. 30: Fruit: length

Observations on the length of the fruit should be made excluding the peduncle.

The length of the fruit for curved or s-shaped fruits should be observed following the C-shape or S-shape.

The length of the fruit with peduncle cavity or/and depressed apex should be observed without taking into account the cavity and depressed apex,


































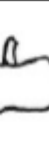


Ad. 31: Fruit: diameter











Observations should be made at the widest part of the fruit.

Ad. 32: Fruit: ratio length/diameter

Observations should be made by comparing the ratio of the fruit with the illustrations for the ratios of shapes in the table.

ratio length/diameter	9 very high					
	8 high to very high					
	7 high					
	6 medium to high					
	5 medium					
	4 low to medium					
	3 low					
	2 low to very low					
	1 very low					

Ad. 33: Fruit: shape in longitudinal section

					
1 rectangular	4 elliptic	7 trapezoid	8 triangular	9 cordate	10 ovate
					
2 square	5 circular				
					
3 transverse rectangular	6 oblate				

Ad. 34: Fruit: curvature

Observations should be made excluding the extreme point of the tip.



1
absent



2
predominantly C-shaped



3
predominantly S-shaped

Ad. 35: Fruit: twisting



1
absent or weak



2
medium



3
strong

Ad. 36: Fruit: shape in cross section

Observations should be made at level of the placenta.

Ad. 37: Fruit: sinuation of pericarp at basal part



1
absent or very weak



3
weak



5
medium



7
strong



9
very strong

Ad. 38: Fruit: sinuation of pericarp excluding basal part



1
absent or weak



2
medium



3
strong

Ad. 40: Fruit: texture of surface



1
smooth or very slightly wrinkled



2
slightly wrinkled



3
strongly wrinkled

Ad. 41: Fruit: color

Fruit: intensity of color (Char. 42)	Fruit: color (Char. 41)			No example varieties known	No example varieties known
	1 yellow	2 orange	3 red	4 brown	5 green
1 very light					
3 light	Deseo, Lumos, Gialte		Doyum, Healey, Teseo		
5 medium	Allrounder, Rialto, Valdor	Arancia, DSP 7054, Jack Miller	Baquero, California Wonder, Greygo		
7 dark	Lalin, Tenor, Verdial	Delirio, Zajda	Angelito, Doux italien, Ettore		
9 very dark			Szegedi 20		

Ad. 42: Fruit: intensity of color

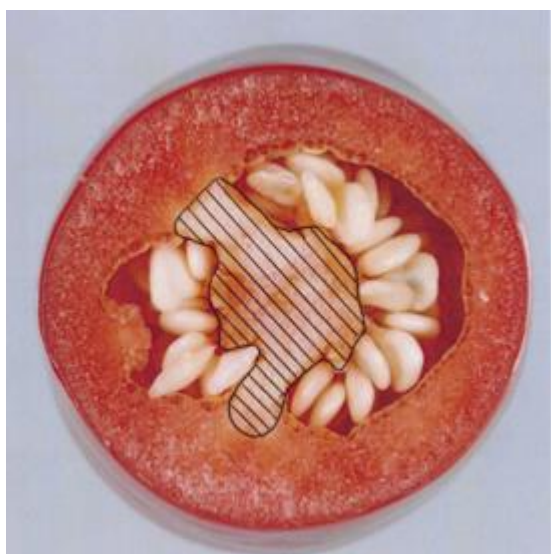
See Ad. 41 for example varieties

Ad. 45: Fruit: depth of interlocutory grooves

Observations should be made on the middle third of the fruit.

Ad. 48: Fruit: capsaicin in placenta

Observations should be made by tasting the placenta, which is the tissue where the seeds are attached to.



Ad. 49: Fruit: seeds



1
absent



9
present

Ad. 51: Peduncle: thickness

Observations should be made at the middle of the peduncle.

Ad. 52: Calyx: aspect

Observations should be made on whether the calyx is not enveloping (1) the fruit, or enveloping the fruit including (3) its shoulder, or partly enveloping the fruit, except the shoulder (2).



1
non enveloping



2
semi enveloping



3
enveloping

Ad. 53: Time of maturity

Observations should be made when at least 50% of the plants show the color change of the fruit.

Ad. 54: Only for vegetable and rootstock varieties: Resistance to Tobamovirus - *Tobacco mosaic virus* - Group 0 (TMV: 0)

1.	Pathogen	Tobamovirus (the genus containing <i>Tobacco mosaic virus</i> (TMV), and <i>Pepper mild mottle virus</i> (PMMoV))
2.	Quarantine status	No
3.	Host species	Sweet pepper, hot pepper, paprika and chili – <i>Capsicum annuum</i> L.
4.	Source of inoculum	GEVES ¹ (FR), Naktuinbouw ² (NL) or INIA ³ (SP)
5.	Isolate	<ul style="list-style-type: none"> - <i>Tobacco mosaic virus</i> group 0 (TMV: 0) strain Vi-6 - <i>Pepper mild mottle virus</i> group 2 (PMMoV: 1.2) strain nt203 - <i>Pepper mild mottle virus</i> group 3 (PMMoV: 1.2.3) strain Eve <p>The test protocols have been validated in a CPVO co-funded project⁴ with these 3 isolates/races</p>
6.	Establishment isolate identity	genetically defined pepper differentials (reference ISF site: http://www.worldseed.org/isf/differential_hosts.html)

	Pepper Tobamovirus Group	0	1	2	3
	ISF Code →	TMV: 0,1,2 ToMV: 0,1,2 BPMoV	TMGMV PaMMV	PMMoV: 1.2	PMMoV: 1.2.3
Differential hosts	Gene				
Lamu, Early Calwonder	-	S	S	S	S
Tisana, Yolo Wonder	L1	HR	S	S	S
Tabasco	L2	HR	HR	S	S
Solario F1, Novi 3, PI159236	L3	HR	HR	HR	S
Tom4, PI260429	L4	HR	HR	HR	HR

S = susceptible; HR = highly resistant; TMV= *Tobacco mosaic virus*; ToMV= *Tomato mosaic virus*; PMMoV= *Pepper mild mottle virus*; TMGMV= *Tobacco mild green mosaic virus*; BPMoV= *Bell pepper mottle virus*; PaMMV= *Paprika mild mottle virus*

7.	Establishment pathogenicity	Test on susceptible plants
8.	Multiplication inoculum	
8.1	Multiplication medium	Regeneration of the virus of plant material before inoculum preparation.
8.2	Multiplication variety	On susceptible pepper variety, Tobamovirus groups may be multiplied on varieties which are selective for each particular group. For TMV, because tomato and tobacco <i>Nicotiana tabacum</i> cv. Samsun have large leaves and can produce a lot of inoculum, they are recommended for the multiplication of TMV: 0.
8.3	Plant stage at inoculation	see 10.3
8.4	Inoculation medium	see 10.1
8.5	Inoculation method	see 10.4
8.6	Harvest of inoculum	Symptomatic fresh leaves
8.7	Check of harvested inoculum	option: on young leaves of <i>Nicotiana tabacum</i> "Xanthi", check for local lesions after 5-7 days at 20-25°C.
8.8	Shelf life/viability inoculum	fresh > 1 day in fridge, desiccated > 1 year in fridge or juice > 1 year in freezer
9.	Format of the test	
9.1	Number of plants per genotype	At least 20 plants
9.2	Number of replicates	-

¹ matref@geves.fr

² resistentie@naktuinbouw.nl

³ resistencias@inia.es

⁴ Harmores 2 CPVO project (<http://www.cpvo.europa.eu/main/en/home/documents-and-publications/technical-projects-reports>)

9.3	Control varieties	<u>TMV: 0:</u> <ul style="list-style-type: none"> - Susceptible controls: Lamu, Pepita, Piquillo - Resistant controls: Fehérözön, Yolo Wonder <u>PMMoV: 1.2:</u> <ul style="list-style-type: none"> - Susceptible controls: Fehérözön, Lamu, Yolo Wonder - Resistant controls: Ferrari, Novi 3 <u>PMMoV: 1.2.3:</u> <ul style="list-style-type: none"> - Susceptible controls: Ferrari, Yolo Wonder - Resistant controls: Friendly, Tom 4 <p>For PMMoV: 1.2.3, it is advised to choose Ferrari as susceptible control because it is resistant to PMMoV: 1.2 or to add the differentials in tests to confirm the group.</p>
9.4	Test design	add non-inoculated plants
9.5	Test facility	Climate room or greenhouse
9.6	Temperature	20-25°C
9.7	Light	12 hours or longer
9.8	Season	-
9.9	Special measures	-
10.	Inoculation	
10.1	Preparation inoculum	<p>1 g leaf with symptoms with 10 mL PBS or similar buffer or dilution of juice in water.</p> <p>Homogenize, add carborundum to buffer</p>
10.2	Quantification inoculum	-
10.3	Plant stage at inoculation	<u>TMV: 0</u> , cotyledons to first leaf stage <u>PMMoV: 1.2 and PMMoV: 1.2.3</u> , cotyledon stage
10.4	Inoculation method	rubbing with the virus suspension
10.5	First observation	<u>TMV:0:</u> 4-7 days post-inoculation for observation of local necrosis. <u>PMMoV: 1.2 and PMMoV: 1.2.3:</u> 4-7 days post-inoculation for observation of local necrotic lesions which can lead to cotyledon drop. After this date these necrosis can hardly be seen on fallen cotyledons
10.6	Second observation	<u>TMV: 0:</u> two weeks post-inoculation for observation of symptoms of susceptibility. <u>PMMoV: 1.2 and PMMoV: 1.2.3:</u> two weeks post-inoculation for observation of symptoms of susceptibility.
10.7	Final observations	<u>TMV: 0:</u> three weeks post-inoculation. <u>PMMoV: 1.2 and PMMoV: 1.2.3:</u> three weeks post-inoculation. For TMV:0, PMMoV: 1.2 and PMMoV: 1.2.3, two of these three observations may be sufficient; the third notation is optional for observation of evolution of symptoms (depending on symptoms on controls or heterogeneous behaviour)
11.	Observations	
11.1	Method	Visual
11.2	Observation scale	<u>TMV: 0:</u> <ul style="list-style-type: none"> - Susceptibility: mosaic (aucuba in case of aucuba strain as Vi-6), growth reduction, death of plants. - Resistance: local necrotic lesions which can lead to leave drop, systemic necrosis, vein necrosis, stem necrosis. <u>PMMoV: 1.2 and PMMoV: 1.2.3:</u> <ul style="list-style-type: none"> - Susceptibility: mosaic (green), growth reduction. - Resistance: local necrotic lesions which can lead to cotyledon drop, systemic necrosis

11.3	Validation of test	evaluation of variety resistance should be calibrated with results of resistant and susceptible controls
11.4	Off-types	-
12.	Interpretation of data in terms of UPOV characteristic states	absent [1] susceptible, see 11.2 present [9] resistant, see 11.2
13.	Critical control points	- For TMV: 0, plants with no symptoms at all have to be interpreted as escapes of inoculation. - Recommended dates of notation should be adapted depending of expression of symptoms on controls. - Environmental conditions can have an effect on the expression of symptoms over time. In this case a third notation could be necessary.

Ad. 55: Only for vegetable and rootstock varieties: Resistance to Tobamovirus - *Pepper mild mottle virus* - Group 2 (PMMoV: 1.2)

See Ad. 54

Ad. 56: Only for vegetable and rootstock varieties: Resistance to Tobamovirus - *Pepper mild mottle virus* - Group 3 (PMMoV: 1.2.3)

See Ad. 54

Ad. 57: Only for vegetable and rootstock varieties: Resistance to *Potato Y virus* (PVY) - Pathotype 0 (PVY: 0)

1.	Pathogen	<i>Potato Y virus</i> (PVY)
2.	Quarantine status	No
3.	Host species	Sweet pepper, hot pepper, paprika and chili – <i>Capsicum annuum</i> L
4.	Source of inoculum	GEVES ⁵ (FR), Naktuinbouw ⁶ (NL) or INIA ⁷ (SP)
5.	Isolate	<ul style="list-style-type: none"> - For PVY: 0 strain zb6 (the test protocol has been validated in a CPVO co-funded project⁸ with this isolate/race). - PVY race 1 - PVY race 2
6.	Establishment isolate identity	genetically defined pepper controls (extract from ISF table ISF website: Differential Hosts – International Seed Federation (worldseed.org)

Differential Host	gene present	PVY: 0	PVY: 1	PVY: 1.2
Early Cal Wonder, Yolo Wonder	<i>pvr 0</i>	S	S	S
PI152225	<i>pvr 1</i>	HR	HR	HR
Yolo Y	<i>pvr1¹</i> (<i>pvr 2¹</i>)	HR	S	S
Florida VR2	<i>pvr1²</i> (<i>pvr 2²</i>)	HR	HR	S
Florida VR4, Del Rey Bell, Agronomico 10	<i>pvr3</i>	HR	HR	HR
Serrano Criollo de Morelos 334	<i>pvr4</i>	HR	HR	HR

S= susceptible; HR= highly resistant

Note: In some scientific publications *pvr 2¹* is referred to as *pvr 1¹*. Similarly, *pvr 2²* is referred to as *pvr 1²*.

7.	Establishment pathogenicity	Test on susceptible plants
8.	Multiplication inoculum	
8.1	Multiplication medium	Regeneration of the virus on plant material before inoculum preparation
8.2	Multiplication variety	On susceptible pepper variety, PVY races may be multiplied on varieties which are selective for each particular race. For PVY: 0, because tobacco <i>Nicotiana tabacum</i> cv. <i>Xanthi-nc</i> has large leaves and can produce a lot of inoculum and has a faster multiplication, it is recommended for the multiplication.
8.3	Plant stage at inoculation	see 10.3
8.4	Inoculation medium	see 10.1
8.5	Inoculation method	see 10.4
8.6	Harvest of inoculum	Symptomatic fresh leaves
8.7	Check of harvested inoculum	option: on <i>Nicotiana tabacum</i> cv. <i>Xanthi-nc</i> , check mosaic presence and local lesion absence (contamination by Tobamovirus) after 5-7 days.
8.8	Shelf life/viability inoculum	fresh > 1 day, desiccated > 1 year. Because problem of stability of PVY: 0, shipments are recommended to be done with fresh infected leaves
9.	Format of the test	
9.1	Number of plants per genotype	At least 20 plants
9.2	Number of replicates	-

⁵ matref@geves.fr

⁶ resistentie@naktuinbouw.nl

⁷ resistencias@inia.es

⁸ Harmores 2 CPVO project (<http://www.cpvo.europa.eu/main/en/home/documents-and-publications/technical-projects-reports>)

9.3	Control varieties	<u>PVY: 0:</u> - Susceptible controls: Ferrari, Piquillo, Yolo Wonder - Resistant controls: Andalus, Vidi, Yolo Y <u>PVV: 1:</u> - Susceptible controls: Yolo Wonder, Yolo Y - Resistant controls: Florida VR2 <u>PVY: 1.2:</u> - Susceptible controls: Florida VR2, Yolo Wonder, Yolo Y - Resistant controls: Serrano Criollo de Morelos
9.4	Test design	add non inoculated plants
9.5	Test facility	Climate room or greenhouse. In case of test in greenhouse during period of low daylight, shadowy area should not be used
9.6	Temperature	18-25°C
9.7	Light	12 hours or longer
9.8	Season	-
9.9	Special measures	For PVY: 0, it is advised to choose Yolo Y as resistant control or to add the differentials in tests to be able to observe a possible contamination by PVY: 1 or 1.2
10.	Inoculation	
10.1	Preparation inoculum	1 g leaf with symptoms with 4 mL PBS with carborundum (80mg) and activated carbon (80mg) or similar buffer, homogenize
10.2	Quantification inoculum	-
10.3	Plant stage at inoculation	PVY: 0: cotyledons stage PVY: 1 and 1.2: cotyledons stage or first pointing leaf stage
10.4	Inoculation method	rubbing with the virus suspension
10.5	Final observations	Three weeks post-inoculation
11.	Observations	
11.1	Method	Visual
11.2	Observation scale	<u>Susceptibility:</u> mosaic (can be very light/faint), growth reduction, vein banding and vein necrosis. <u>Resistance:</u> no symptoms
11.3	Validation of test	evaluation of variety resistance should be calibrated with results of resistant and susceptible controls.
11.4	Off-types	-
12.	Interpretation of data in terms of UPOV characteristic states	absent [1] susceptible, see 11.2 present [9] resistant, see 11.2
13.	Critical control points	Recommended dates of notation should be adapted depending of expression of symptoms on controls.

Ad. 58: Only for vegetable and rootstock varieties: Resistance to *Potato Y virus* (PVY) - Pathotype 1 (PVY: 1)

See Ad. 57

Ad. 59: Only for vegetable and rootstock varieties: Resistance to *Potato Y virus* (PVY) - Pathotype 1.2 (PVY: 1.2)

See Ad. 57

Ad. 60: Only for vegetable and rootstock varieties: Resistance to *Phytophthora capsici* (Pc)

1.	Pathogen	<i>Phytophthora capsici</i> (Pc)
2.	Quarantine status	no
3.	Host species	<i>Capsicum annuum</i>
4.	Source of inoculum	Naktuinbouw (NL) - INRA GAFL (FR)
5.	Isolate	moderately aggressive (e.g. strain P0277)
6.	Establishment isolate identity	on standards Jupiter, Yolo Wonder (susceptible), Favorol (moderately resistant), Solario, Phyto 636 (resistant)
7.	Establishment pathogenicity	in biotest on plants
8.	Multiplication inoculum	
8.1	Multiplication medium	V8 juice-agar (1%) or 10% V8A or PDA+
8.2	Multiplication variety	-
8.3	Plant stage at inoculation	-
8.4	Inoculation medium	10% V8A or PDA+
8.5	Inoculation method	see 10.4
8.6	Harvest of inoculum	-
8.7	Check of harvested inoculum	-
8.8	Shelf life/viability inoculum	10% V8A 3 months, PDA+ 2 months
9.	Format of the test	
9.1	Number of plants per genotype	at least 20 (2 untreated plants)
9.2	Number of replicates	e.g. 1
9.3	Control varieties	Jupiter, Yolo Wonder (susceptible), Favorol (moderately resistant), Solario (resistant)
9.4	Test design	-
9.5	Test facility	glasshouse
9.6	Temperature	22°C d/n
9.7	Light	at least 12h
9.8	Season	-
9.9	Special measures	-
10.	Inoculation	
10.1	Preparation inoculum	growing on Petri dishes
10.2	Quantification inoculum	-
10.3	Plant stage at inoculation	first flower bud
10.4	Inoculation method	stem is cut just below point of first branching, a 4mm- agar plug is placed carefully on the wound and covered with aluminum foil
10.5	First observation	7 days post inoculation
10.6	Second observation	14 days post inoculation
10.7	Final observations	21 days post inoculation
11.	Observations	
11.1	Method	visual, comparative or measurement of stem necrosis length; for repeated measurements, the stem is marked with permanent ink
11.2	Observation scale	
	[1] absent	e.g. length increase > 0.8 cm/week
	[9] present (moderately resistant)	e.g. length increase $\geq 0.5 \text{ cm} \leq 0.8 \text{ cm/week}$
	[9] present (highly resistant)	e.g. length increase < 0.5 cm/week
11.3	Validation of test	on standards
11.4	Off-types	maximum 1 on 20 plants
12.	Interpretation of data in terms of UPOV characteristic states	QL Based on the stem necrosis increase compared to the standards. [1] susceptible: Jupiter, Yolo Wonder [9] moderately resistant: Favorol [9] resistant: Solario
13.	Critical control points	- Absence of differential interactions between host and pathogen - Maintenance of viability of the strains in the collection

Ad. 61: Only for vegetable and rootstock varieties: Resistance to *Cucumber mosaic virus* (CMV)

1.	Pathogen	<i>Cucumber mosaic virus</i> (CMV)
2.	Quarantine status	no
3.	Host species	<i>Capsicum annuum</i>
4.	Source of inoculum	INRA GAFL (FR)
5.	Isolate	e.g. 'Fulton'
6.	Establishment isolate identity	-
7.	Establishment pathogenicity	-
8.	Multiplication inoculum	
8.1	Multiplication medium	living plant
8.2	Multiplication variety	e.g. <i>Vinca rosea</i>
8.3	Plant stage at inoculation	-
8.4	Inoculation medium	0.03 M PBS + 0.1% DIECA
8.5	Inoculation method	rubbing with carborundum
8.6	Harvest of inoculum	1 g on 4 ml buffer
8.7	Check of harvested inoculum	-
8.8	Shelf life/viability inoculum	-
9.	Format of the test	
9.1	Number of plants per genotype	50
9.2	Number of replicates	e.g. 1
9.3	Control varieties	Yolo Wonder (susceptible), Ducato (moderately resistant), Alby, Favorol (resistant)
9.4	Test design	-
9.5	Test facility	-
9.6	Temperature	20-22°C
9.7	Light	12h
9.8	Season	-
9.9	Special measures	-
10.	Inoculation	
10.1	Preparation inoculum	-
10.2	Quantification inoculum	-
10.3	Plant stage at inoculation	cotyledon, before emergence of first leaf (12-13 days after sowing)
10.4	Inoculation method	rubbing cotyledons with carborundum, followed by 48h darkness
10.5	First observation	10 days post inoculation
10.6	Second observation	15 days post inoculation
10.7	Final observations	21 days post inoculation
11.	Observations	
11.1	Method	visual, comparative
11.2	Observation scale	
	[1] susceptible	many local lesions, mosaic
	[9] moderately resistant	intermediate symptoms
	[9] highly resistant	few local lesions, no or light symptoms
11.3	Validation of test	on standards
11.4	Off-types	maximum 1 on 20 plants
12.	Interpretation of data in terms of UPOV characteristic states	QL
13.	Critical control points	-

Ad. 62: Only for vegetable and rootstock varieties: Resistance to *Tomato spotted wilt virus* Pathotype 0 (TSWV: 0)

1.	Pathogen	<i>Tomato spotted wilt virus</i> , Pathotype 0 (TSWV: 0)
2.	Quarantine status	yes
3.	Host species	<i>Capsicum annuum</i>
4.	Source of inoculum	GEVES (FR), Naktuinbouw (NL), INIA (ES)
5.	Isolate	e.g. LYE 51 or Br-01
6.	Establishment isolate identity	-
7.	Establishment pathogenicity	on susceptible plant or <i>Nicotiana benthamiana</i> , <i>N. rustica</i>
8.	Multiplication inoculum	
8.1	Multiplication medium	living plant
8.2	Multiplication variety	Yolo Wonder or <i>N. benthamiana</i> , <i>N. rustica</i>
8.3	Plant stage at inoculation	cotyledons fully developed or at "first leaf" pointed stage or 1- 3 leaves
8.4	Inoculation medium	ice-cold buffer suspension or 0.03 M PBS + optional addition of 0.1% sodium sulfite freshly added
8.5	Inoculation method	rubbing with carborundum
8.6	Harvest of inoculum	-
8.7	Check of harvested inoculum	-
8.8	Shelf life/viability inoculum	stability in ice cold suspension ca. 15-20 minutes
9.	Format of the test	
9.1	Number of plants per genotype	at least 20
9.2	Number of replicates	e.g. 1
9.3	Control varieties	Lamuyo, Yolo Wonder (susceptible), Galileo, Jackal, Jackpot, Prior (resistant)
9.4	Test design	-
9.5	Test facility	growth chamber or insect proof glasshouse
9.6	Temperature	18-20°C or 20-22°C
9.7	Light	12 h
9.8	Season	all seasons, but winter reduce the risk of thrips infestation
9.9	Special measures	biohazard sign on compartment for countries with a TSWV quarantine status
10.	Inoculation	
10.1	Preparation inoculum	-
10.2	Quantification inoculum	-
10.3	Plant stage at inoculation	cotyledons fully developed / at "first leaf" pointed stage or 1-3 leaves
10.4	Inoculation method	rubbing with carborundum, then apply shading or darkness for 24h option: repeat the inoculation 2-3 days later to reduce accidental escapes
10.5	First observation	5-6 days to 10 - 15 days post inoculation
10.6	Second observation	10-11 days post inoculation to 15 - 21 days post inoculation
10.7	Final observations	21 days post inoculation
11.	Observations	
11.1	Method	visual, comparative
11.2	Observation scale	
	[1] absent	mosaic on young leaf, some leaf malformation
	[9] present	necrosis or only mechanical damage
11.3	Validation of test	on standards
11.4	Off-types	maximum 1 on 20 plants
12.	Interpretation of data in terms of UPOV characteristic states	QL
13.	Critical control points	Monitor and control the presence of thrips. TSWV is transmitted by thrips (<i>Thrips tabaci</i> and <i>Frankliniella occidentalis</i>). TSWV has a broad host range. After a few multiplication the virus could be ineffective. New isolates can be obtained from practice by harvesting fruits of L4 pepper varieties infected naturally with TSWV. The fruits are kept at -70°C temperature. The presence of other viruses must be checked before using this material.

Ad. 63: Only for vegetable and rootstock varieties: Resistance to *Xanthomonas campestris* pv. *vesicatoria* (now *Xanthomonas* ssp) / 2026 (Xcv) (now X spp) - Pathotype 1

1.	Pathogen	<i>Xanthomonas campestris</i> pv. <i>vesicatoria</i> (now <i>Xanthomonas</i> ssp) / 2026 (Xcv) (now X spp)
2.	Quarantine status	-
3.	Host species	<i>Capsicum annuum</i>
4.	Source of inoculum	natural; to be taken from any source of infection in the field
5.	Isolate	expected reactions on resistant standard varieties
6.	Establishment isolate identity	on differentials

Differential	Pathotype 1	Pathotype 2	Pathotype 3
Early California Wonder	S	S	S
Early California Wonder-10R (gene Bs1)	S	R	S
Early California Wonder-20R (gene Bs2)	R	R	R
Early California Wonder-30R (gene Bs3)	R	S	S
PI 235047 (gene Bs4)	R	S	R

7.	Establishment pathogenicity	-
8.	Multiplication inoculum	-
8.1	Multiplication medium	a bacterial growth medium, e.g. LPGA
8.2	Multiplication variety	-
8.3	Plant stage at inoculation	-
8.4	Inoculation medium	-
8.5	Inoculation method	-
8.6	Harvest of inoculum	48h culture
8.7	Check of harvested inoculum	-
8.8	Shelflife/viability inoculum	-
9.	Format of the test	-
9.1	Number of plants per genotype	at least 20
9.2	Number of replicates	e.g. 1
9.3	Control varieties	Fehérözön, Yolo Wonder (susceptible), Emiro, Filidor, Gotico, San Marco, Solanor (resistant)
9.4	Test design	-
9.5	Test facility	-
9.6	Temperature	20-26°C day/night
9.7	Light	30.000 lux suggested, 16h/day
9.8	Season	-
9.9	Special measures	80% RH
10.	Inoculation	-
10.1	Preparation inoculum	harvest cells from LPGA plate after 48 h growing
10.2	Quantification inoculum	10 ⁷ -10 ⁸ cells per ml (Stronger reaction with the higher concentration.)
10.3	Plant stage at inoculation	6-8 true leaves
10.4	Inoculation method	infiltration into abaxial surface of the interveinal region on either side of the midrib of a fully expanded leaf in 13-20mm diameter spots
10.5	First observation	2-5 days post inoculation
10.6	Second observation	6-8 days post inoculation
10.7	Final observations	10-14 days post inoculation
11.	Observations	-
11.1	Method	visual, comparative
11.2	Observation scale	-
	[1] absent	water soaking near infiltration site
	[9] present	necrotic reaction at infiltration site
11.3	Validation of test	on standards
11.4	Off-types	maximum 1 on 20 plants

12.	Interpretation of data in terms of UPOV characteristic states	QL
13.	Critical control points	-

Ad. 64: Only for vegetable and rootstock varieties: Resistance to *Xanthomonas campestris* pv. *vesicatoria* (now *Xanthomonas* spp) / 2026 (Xcv) (now X spp) - Pathotype 2

See Ad. 63


Ad. 65: Only for vegetable and rootstock varieties: Resistance to *Xanthomonas campestris* pv. *vesicatoria* (now *Xanthomonas* spp) / 2026 (Xcv) (now X spp) - Pathotype 3

See Ad. 63

Ad. 66: Only for vegetable and rootstock varieties: Resistance to *Meloidogyne incognita*

1.	Pathogen	<i>Meloidogyne incognita</i>
2.	Quarantine status	-
3.	Host species	Sweet pepper, hot pepper, paprika and chili – <i>Capsicum annuum</i> L.
4.	Source of inoculum	GEVES ⁹ (F)
5.	Isolate	non-resistance breaking
6.	Establishment isolate identity	use pepper standards
7.	Establishment pathogenicity	use susceptible pepper standards
8.	Multiplication inoculum	
8.1	Multiplication medium	living plant of pepper or tomato
8.2	Multiplication variety	susceptible variety
8.3	Plant stage at inoculation	2 nd leaf stage
8.5	Inoculation method	deposit of piece of contaminated roots in soil (around 5-10g near each plant, to adapt depending of the population aggressivity)
8.6	Harvest of inoculum	6 to 10 weeks after inoculation, root systems are cut with scissors into pieces of about 1 cm length
8.7	Check of harvested inoculum	visual check for presence of root knots and ripe egg masses
8.8	Shelf life/viability inoculum	1 day
9.	Format of the test	
9.1	Number of plants per genotype	30 plants. It is recommended to sow more seeds to be sure to get enough plants.
9.2	Number of replicates	at least 2, preferably 3 replicates
9.3	Control varieties	Susceptible: Tom 4; Yolo Wonder as additional susceptible control for reduced susceptibility, indicating the border between susceptible and resistant Resistant: Capital and W4
9.4	Test design	3 replicates in separate trays with contaminated substrate (70% soil +30% sand) to allow statistical analysis. 1 separate tray with NON contaminated substrate.
9.5	Test facility	greenhouse or climate room
9.6	Temperature	20-26°C, the temperature should be adapted depending on the aggressivity of the test to obtain expected response of controls but should not be above 26°C.
9.7	Light	at least 12 h per day.

⁹ GEVES; matref@geves.fr

10.1	Preparation inoculum	small pieces of diseased roots mixed with soil.
10.2	Quantification inoculum	Quantity of inoculum is depending of aggressiveness of test and growing conditions (e.g. between 15 g to 30 g of infested roots, for 40 plants in a tray of 30*30 cm containing approximately 3.5 kg of substrate,). Galls should be homogeneously mixed with soil.
10.3	Plant stage at inoculation	seed
10.4	Inoculation method	seed sown in soil contaminated with galls.
10.5	First observation	-
10.6	Second observation	-
10.7	Final observations	Around 45 days after inoculation depending on test conditions (temperature, season).
11.	Observations	
11.1	Method	root inspection
11.2	Observation scale	<p>Class 0: healthy plant, no galls</p> <p>Class 1: few and little galls which are difficult to find (for example less than 5)</p> <p>Class 2: few galls, easy to observe but on few roots, still a lot of roots without galls, no chains</p> <p>Class 3: many individual galls on most but not all roots, presence of chains</p> <p>Class 4: many galls on all roots, can lead to dead plants and may suppress emergence</p>
11.3	Validation of test	validation on controls.
12.	Interpretation of data in terms of UPOV characteristic states	<ul style="list-style-type: none"> - Variety very similar to resistant control is judged as resistant: Resistance is present (9); - Variety very similar to susceptible controls is judged as susceptible: Resistance is absent (1); - If significantly different from resistant and susceptible controls (notations are between resistant and susceptible controls), the variety is judged as resistant. - If results are not clear, statistical analysis is advised. 
13.	Critical control points	Avoid overwatering. This may result in rotting of roots. In case of aggressive test, put seeds in a layer of non-contaminated soil or decrease the quantity of inoculum.

8.3 *Types of varieties:*

Vegetable and rootstock types:

Breeding is mainly done for the fresh fruit on its visual appearance, color, pungency, shape, size, flavor etc. and for agronomic traits and yield as well as resistances. The plants are usually grown in soil or on substrate. For processed fruits and for dried fruits also special objectives like endocarp/seeds ratio, soluble solids content, dry weight, etc. are important. Vegetable varieties with snack fruits are sometimes bred for growing in pots.

Ornamental types (O):

Breeding is mainly done in a gene pool which is different from the vegetable and rootstock varieties. The plant is usually grown in greenhouses in pots. For the ornamental varieties the visual appearance of flowers, leaves and fruits, plant size and shape in relation to pot size are important objectives of breeding.

In case a variety has a double purpose, i.e. as vegetable as well as ornamental, it is considered to be a vegetable.

9. Literature

GENERAL INFORMATION

[Florabase—the Western Australian Flora \(dpaw.wa.gov.au\)](http://dpaw.wa.gov.au)

Palloix, A., Phaly, T., 1996: [Histoire du piment: de la plante sauvage aux variétés modernes](#), PHM Revue Horticole, FR, no. 365; pp. 41-43

Pochard, E., 1987: [Histoire du piment et recherche](#), INRA Mensuel, FR, no. 29; pp. 5-8

Pochard, E., Palloix, A., Daubeze, A.M., 1992: [Le piment](#), Gallais, A. (ed.), Bannerot, H. (ed.), Amelioration des especes vegetales cultivees. Objectifs et critères de selection pp. 420-434, INRA; Paris, FR

do Rêgo, E. R., do Rêgo, M. M., 2016: Genetics and Breeding of Chili Pepper Capsicum spp. In: do Rego, E.R. et al. 2016: Production and Breeding of Chilli Peppers (Capsicum spp.) Chapter 4, Springer International Publishing Switzerland.

Smilde, W.D. and D. Peters (2007) Pathotyping TSWV in pepper and tomato. In: Niemorowicz-Szczytt, K. 2007: Progress in Research on Capsicum and Eggplant, Eucarpia conference proceedings, Warsaw, pp. 231-236 (<http://www.eucarpia.org/03publications/#Abstracts>)

Somos, A., 1984: The Paprika, Akadémiai Kiadó, Budapest, HU.

Genetic Resources

Daunay, M.C., Jullian, E., Dauphin, F., 2001: [Management of eggplant and pepper genetic resources in Europe: networks are emerging](#), EUCARPIA, European Association for Research on Plant Breeding, Paris, FR, Genetics and breeding of Capsicum and eggplant, 11th EUCARPIA Meeting, Antalya, TR, 2001 pp.1-5

Disease Resistance

Caranta, C., Palloix, A., Gébré-Sélassié, K., Marchoux, G., Lefebvre, V., Daubèze, A.M., 1996: [Genomic organization of multi-virus resistance factors in pepper \(Capsicum annuum\): Co-localization between QTLs and major genes. Poster](#)

Lefebvre, V., Caranta, C., Moury, B., Pflieger, S., Daubèze, A.M., Blattes, A., Phaly, T., Nemouchi, G., Palloix, A., 1997: [Status of the intraspecific molecular map of pepper: genome distribution of multiple disease resistance loci and defence genes](#), Sherago International Inc., New York, US, Plant and animal genome V, International Conference on the Status of Plant and Animal Genome Research, San Diego, US, 1997/01/12-16, pp. 115

Pflieger, S., Lefebvre, V., Blattes, A., Caranta, C., Palloix, A., 1998: [Candidate gene approach for identifying QTLs involved in pepper/pathogen interactions](#), EUCARPIA, European Association for Research on Plant Breeding, Avignon, FR, Genetics and breeding of Capsicum and eggplant, 10th Meeting EUCARPIA, Avignon, FR, 1998/09/07-11, pp. 245-248

Stacey, G. (ed.), Mullin, B. (ed.), Gresshoff, P.M. (ed.), Biology of plant-microbe interactions
8. International Symposium on molecular plant-microbe interactions, Knoxville (USA), 1996/07/12-19, 1 p., International Society for Molecular Plant-Microbe Interactions, Saint-Paul, US

Potyvirus

Parrella, G., Ruffel, S., Moretti, A., Morel, C., Palloix, A., Caranta, C., 2002: [Recessive resistance genes against potyviruses are localized in colinear genomic regions of the tomato \(Lycopersicon spp.\) and pepper \(Capsicum spp.\) genomes](#), Theoretical and Applied Genetics, DE, vol. 105; pp. 855-861

Ruffel, S., Dussault, M.H., Palloix, A., Moury, B., Bendahmane, A., Robaglia, C., Caranta, C., 2002: [A natural](#)

[recessive resistance gene against potato virus Y in pepper corresponds to the eukariotic initiation factor 4E \(eIF4E\)](#), Plant Journal, GB, vol. 32 no. 6; pp. 1067-1075

CMV

Caranta, C., Daubèze, A.M., Pflieger, S., Lefebvre, V., Thabuis, A., Blattes, A., Nemouchi, G., Phaly, T., Signoret, P., Palloix, A., 2001: [Identification of quantitative trait loci involved in partial restriction of cucumber mosaic virus \(CMV\) long-distance movement in pepper](#), EUCARPIA, European Association for Research on Plant Breeding, Paris (FRA), Genetics and breeding of Capsicum and eggplant, 11th EUCARPIA Meeting, Antalya, TR, 2001 pp. 176-180

Caranta, C., Palloix, A., Lefebvre, V., Daubèze, A.M., 1997: [QTLs for a component of partial resistance to cucumber mosaic virus in pepper: restriction of virus installation in host-cells](#), Theoretical and Applied Genetics, DE, no. 94; pp. 431-438

Caranta, C., Pflieger, S., Lefebvre, V., Daubèze, A.M., Thabuis, A., Palloix, A., 2002: [QTLs involved in the restriction of cucumber mosaic virus \(CMV\) long-distance movement in pepper](#), Theoretical and Applied Genetics, DE, vol. 104; pp. 586-591

Phytophthora

Lefebvre, V., Palloix, A., 1995: [Mapping QTL's affecting the resistance to Phytophthora capsici in pepper \(Capsicum annuum\)](#), Scherago International Inc., New York, US, USDA, United States Department of Agriculture, Agricultural Research Service, Washington, US, International Conference on the Status of Plant Genome Research, Plant Genome 3, San Diego, US, 1995/01/15-19 58, USDA-ARS, Washington, US

Lefebvre, V., Palloix, A., 1996: [Both epistatic and additive effects of QTLs are involved in polygenic induced resistance to disease: a case study, the interaction pepper Phytophthora capsici Leonian](#), Theoretical and Applied Genetics, DE, no. 93; pp. 503-511

Thabuis, A., Palloix, A., Pflieger, S., Daubèze, A.M., Caranta, C., Lefebvre, V., 2003: [Comparative mapping of Phytophthora resistance loci in pepper germplasm: evidence for conserved resistance loci across Solanaceae and for a large genetic diversity](#), Theoretical and Applied Genetics, DE, vol. 106; pp. 1473-1485

Xanthomonas

Márkus, F., Kapitány, J., Csilléry, G. and Szarka, J., 2001 b: *Xanthomonas* resistance In Hungarian spice pepper varieties. Int. Jour. of Hort. Sci., Voil. 7. No. 3-4. pp. 69-72

Szarka, J. and Csilléry, G., 1995: Defence system against *Xanthomonas campestris* pv. *vesicatoria*. Eucarpia IXth Meeting on Genetics and Breeding of Capsicum and Eggplant. Budapest, Hungary, August 21-25. pp. 184-187

TSWV

Moury, B., Pflieger, S., Blattes, A., Lefebvre, V., Palloix, A., 2000: [A CAPS marker to assist selection of tomato spotted wilt virus \(TSWV\) resistance in pepper](#), Genome, CA, no. 43; pp.137-142

10. Technical Questionnaire

TECHNICAL QUESTIONNAIRE	Page {x} of {y}	Reference Number:
-------------------------	-----------------	-------------------

	Application date: (not to be filled in by the applicant)
--	---

TECHNICAL QUESTIONNAIRE to be completed in connection with an application for plant breeders' rights	
1. Subject of the Technical Questionnaire	
1.1 Botanical name	<input type="text" value="Capsicum annuum L."/>
1.2 Common name	<input type="text" value="Sweet Pepper, Hot Pepper, Paprika, Chili"/>
2. Applicant	
Name	<input type="text"/>
Address	<input type="text"/>
Telephone No.	<input type="text"/>
Fax No.	<input type="text"/>
E-mail address	<input type="text"/>
Breeder (if different from applicant)	<input type="text"/>
3. Proposed denomination and breeder's reference	
Proposed denomination (if available)	<input type="text"/>
Breeder's reference	<input type="text"/>

TECHNICAL QUESTIONNAIRE	Page {x} of {y}	Reference Number:
-------------------------	-----------------	-------------------

#4.	Information on the breeding scheme and propagation of the variety						
4.1	Breeding scheme						
	Variety resulting from:						
4.1.1	Crossing						
	<table style="width: 100%; border: none;"> <tr> <td style="width: 70%;">(a) controlled cross</td> <td style="width: 30%; text-align: right;">[]</td> </tr> <tr> <td>(b) partially known cross</td> <td style="text-align: right;">[]</td> </tr> <tr> <td>(c) unknown cross</td> <td style="text-align: right;">[]</td> </tr> </table>	(a) controlled cross	[]	(b) partially known cross	[]	(c) unknown cross	[]
(a) controlled cross	[]						
(b) partially known cross	[]						
(c) unknown cross	[]						
4.1.2	Mutation (please state parent variety)						
	[]						
	<div style="border: 1px solid black; height: 40px; width: 100%;"></div>						
4.1.3	Discovery and development (please state where and when discovered and how developed)						
	[]						
	<div style="border: 1px solid black; height: 40px; width: 100%;"></div>						
4.1.4	Other (Please provide details)						
	[]						
	<div style="border: 1px solid black; height: 40px; width: 100%;"></div>						

TECHNICAL QUESTIONNAIRE	Page {x} of {y}	Reference Number:
-------------------------	-----------------	-------------------

4.2 Method of propagating the variety

4.2.1 Seed-propagated varieties

- | | | |
|-----|--------------------------------|-----|
| (a) | Self-pollination | [] |
| (b) | Cross-pollination | [] |
| (c) | Hybrid | [] |
| (d) | Other (please provide details) | [] |

--

4.2.2 Other []
(Please provide details)

--

TECHNICAL QUESTIONNAIRE	Page {x} of {y}	Reference Number:
-------------------------	-----------------	-------------------

5. Characteristics of the variety to be indicated (the number in brackets refers to the corresponding characteristic in Test Guidelines; please mark the note which best corresponds).

Characteristics	Example Varieties	Note
5.1 Plant: height (3)		
very short		1 []
very short to short		2 []
short	Bravia	3 []
short to medium		4 []
medium	HRF	5 []
medium to tall		6 []
tall	Century	7 []
tall to very tall		8 []
very tall	Brutus	9 []
5.2 Plant: shortened internodes (4)		
absent	California wonder, De Cayenne	1 []
present	Bucano	9 []
5.3 <u>Only for ornamental varieties:</u> Leaf blade: intensity of anthocyanin coloration of upper side (14)		
absent or very weak		1 []
weak	Omiyamurasaki (O), Purple Rain (O)	2 []
medium	Calico (O)	3 []
strong	Black Pearl (O)	4 []
very strong	Purple Flash (O), Takiama Purple to Red (O), TF802 (o)	5 []
not applicable		[]
5.4 <u>Only for ornamental varieties:</u> Leaf blade: distribution of anthocyanin coloration of lower side (15)		
absent		1 []
on veins throughout	Takiama Purple to Red (O)	2 []
on veins and diffuse on distal part		3 []
on veins and diffuse throughout	Black Pearl (O), Purple Flash (O)	4 []
throughout	TF802 (o)	5 []
not applicable		[]

Characteristics	Example Varieties	Note
5.5 (16) <u>Only for ornamental varieties:</u> Leaf blade: variegation		
absent	Omiyamurasaki (O)	1 []
present	Calico (O), Purple Rain (O)	9 []
not applicable		[]
5.6 (23) Flower: anthocyanin coloration of anther		
absent	Bravia	1 []
present	Brutus, Lamuyo	9 []
5.7 (25) Male sterility		
absent	California wonder	1 []
partially present		2 []
totally present	Angelito	3 []
5.8 (26) Immature fruit: color		
greenish white	Bravia	1 []
greenish yellow	Don, Sweet banana	2 []
green	Allrounder, Black Bullet, Cornus, Hitman, Impala, Syrto	3 []
purple	Cardinal, Lilo, Loco, Tequila, Tonaya	4 []
5.9 (27) <u>Only varieties with immature fruit: color green or purple:</u> intensity of color		
very light		1 []
very light to light		2 []
light	Cornus, Loco, Syrto	3 []
light to medium	Tequila	4 []
medium	Allrounder	5 []
medium to dark	Cardinal	6 []
dark	Impala, Lilo, Tonaya	7 []
dark to very dark		8 []
very dark	Black Bullet, Hitman	9 []
not applicable		[]

Characteristics	Example Varieties	Note
5.10 Fruit: length (30)		
very short	Cherry Bomb, PAZ szentesi	1 []
very short to short		2 []
short	Ophelia, Smolder	3 []
short to medium		4 []
medium	California wonder	5 []
medium to long		6 []
long	Bravia, De Cayenne	7 []
long to very long		8 []
very long	Carboni, Corno di toro rosso, Doux très long des Landes	9 []
5.11 Fruit: diameter (31)		
very narrow	De Cayenne	1 []
very narrow to narrow		2 []
narrow	Cherry Bomb	3 []
narrow to medium		4 []
medium	Doux italien	5 []
medium to broad		6 []
broad	Lamuyo, Maduro	7 []
broad to very broad		8 []
very broad	Floridor, Ibleor	9 []
5.12 Fruit: ratio length/diameter (32)		
very low	Liebesapfel, PAZ szentesi	1 []
very low to low		2 []
low	Bucano	3 []
low to medium		4 []
medium	Maduro	5 []
medium to high		6 []
high	Lamuyo, Vidi	7 []
high to very high		8 []
very high	De Cayenne, Doux très long des Landes	9 []

Characteristics	Example Varieties	Note
5.13 Fruit: shape in longitudinal section (33)		
rectangular	Raggio	1 []
square	Maranello	2 []
transverse rectangular	Liebesapfel, PAZ szentesi	3 []
elliptic		4 []
circular	Capperino	5 []
oblate	Koral	6 []
trapezoid	Altea	7 []
triangular	Bravia, Corno di toro rosso, De Cayenne	8 []
cordate	Morrón de conserva 3	9 []
ovate	Jalapeño	10 []
5.14 Fruit: sinuation of pericarp at basal part (37)		
absent or very weak	Smolder	1 []
very weak to weak		2 []
weak	Donat, Kappy	3 []
weak to medium		4 []
medium	Banán	5 []
medium to strong		6 []
strong	Hawker	7 []
strong to very strong		8 []
very strong	Doux italien, Gelber Spiral	9 []
5.15 Fruit: sinuation of pericarp excluding basal part (38)		
absent or weak	Sonar, Yolo Wonder	1 []
medium	Rodri	2 []
strong	De Cayenne, Doux italien	3 []
5.16 Fruit: color (41)		
yellow	Allrounder	1 []
orange	Ariane	2 []
red	Lamuyo	3 []
brown	Chocolony	4 []
green		5 []

Characteristics	Example Varieties	Note
5.17 Fruit: intensity of color (42)		
very light		1 []
very light to light		2 []
light		3 []
light to medium		4 []
medium		5 []
medium to dark		6 []
dark		7 []
dark to very dark		8 []
very dark		9 []
5.18 Fruit: depth of peduncle cavity (44)		
absent or very shallow	Sweet banana	1 []
very shallow to shallow		2 []
shallow	Doux italien	3 []
shallow to medium		4 []
medium	Lamuyo, Maduro	5 []
medium to deep		6 []
deep	Baquero	7 []
deep to very deep		8 []
very deep	Dumbo34	9 []
5.19 Fruit: number of locules (46)		
predominantly two	De Cayenne	1 []
equally two and three	Banán	2 []
predominantly three	Century	3 []
equally three and four	Lamuyo, Sonar	4 []
predominantly four	PAZ szentesi	5 []
5.20 Fruit: capsaicin in placenta (48)		
absent	Sonar, Sweet banana	1 []
present	De Cayenne	9 []
5.21 Fruit: seeds (49)		
absent	Angelito	1 []
present	Lamuyo	9 []

Characteristics	Example Varieties	Note
5.22 Time of maturity (53)		
very early	Macska sárga, Madison	1 []
early	Kosmik	3 []
early to medium		4 []
medium	Lamuyo, Sonar	5 []
medium to late		6 []
late	Doux d'Espagne	7 []
late to very late		8 []
very late	Teseo	9 []
5.23 <u>Only for vegetable and rootstock varieties:</u> Resistance to (54) Tobamovirus - Tobacco mosaic virus - Group 0 (TMV: 0)		
absent	Lamu, Pepita, Piquillo	1 []
present	Fehérözön, Turia, Ultron, Yolo Wonder	9 []
5.24 <u>Only for vegetable and rootstock varieties:</u> Resistance to (55) Tobamovirus - Pepper mild mottle virus - Group 2 (PMMoV: 1.2)		
absent	Fehérözön, Lamu, Turia, Yolo Wonder	1 []
present	Achille, Candela, Ferrari, Fudji, Novi 3, PI 15225	9 []
5.25 <u>Only for vegetable and rootstock varieties:</u> Resistance to (56) Tobamovirus - Pepper mild mottle virus - Group 3 (PMMoV: 1.2.3)		
absent	Candela, Ferrari, Oida, Yolo Wonder	1 []
present	Bisonte, Ettore, Friendly, Tom4	9 []
5.26 <u>Only for vegetable and rootstock varieties:</u> Resistance to (57) Y virus (PVY) - Pathotype 0 (PVY: 0)		
absent	Ferrari, Murillo, Piquillo, Yolo Wonder	1 []
present	Andalus, Goleador, Vidi, Yolo Y	9 []
5.27 <u>Only for vegetable and rootstock varieties:</u> Resistance to (58) Y virus (PVY) - Pathotype 1 (PVY: 1)		
absent	Yolo Wonder, Yolo Y	1 []
present	Florida VR2, Ribatejo	9 []
not tested		[]
5.28 <u>Only for vegetable and rootstock varieties:</u> Resistance to (59) Y virus (PVY) - Pathotype 1.2 (PVY: 1.2)		
absent	Florida VR2, Yolo Wonder, Yolo Y	1 []
present	Chouca, Serrano Criollo de Morelos 334	9 []
note tested		[]
5.29 <u>Only for vegetable and rootstock varieties:</u> Resistance to (60) Phytophthora capsici (Pc)		
absent	Yolo Wonder	1 []
present	Chistera, Favolor, Phyo 636, Solario	9 []
not tested		[]

Characteristics	Example Varieties	Note
5.30 (61) <u>Only for vegetable and rootstock varieties:</u> Resistance to <i>Cucumber mosaic virus</i> (CMV)		
absent	Yolo Wonder	1 []
present	Alby, Favolor	9 []
not tested		[]
5.31 (62) <u>Only for vegetable and rootstock varieties:</u> Resistance to <i>Tomato spotted wilt virus</i> Pathotype 0 (TSWV: 0)		
absent	Yolo Wonder	1 []
present	Galileo, Jackal, Jackpot, Piamonte	9 []
5.32 (63) <u>Only for vegetable and rootstock varieties:</u> Resistance to <i>Xanthomonas campestris</i> pv. <i>vesicatoria</i> (now <i>Xanthomonas</i> spp) / 2026 (Xcv) (now X spp) - Pathotype 1		
absent	Yolo Wonder	1 []
present	Filidor, San Marco	9 []
not tested		[]
5.33 (64) <u>Only for vegetable and rootstock varieties:</u> Resistance to <i>Xanthomonas campestris</i> pv. <i>vesicatoria</i> ((now <i>Xanthomonas</i> spp) / 2026 (Xcv) (now X spp) - Pathotype 2		
absent	Yolo Wonder	1 []
present	Filidor, San Marco	9 []
not tested		[]
5.34 (65) <u>Only for vegetable and rootstock varieties:</u> Resistance to <i>Xanthomonas campestris</i> pv. <i>vesicatoria</i> (now <i>Xanthomonas</i> spp) / 2026 (Xcv) (now X spp) - Pathotype 3		
absent	Yolo Wonder	1 []
present	Filidor, San Marco	9 []
not tested		[]
5.35 (66) <u>Only for vegetable and rootstock varieties:</u> Resistance to <i>Meloidogyne incognita</i>		
absent	Tom4, Yolo Wonder	1 []
present	Bastion, Capital, Kation, W4	9 []
not tested		[]

TECHNICAL QUESTIONNAIRE	Page {x} of {y}	Reference Number:
-------------------------	-----------------	-------------------

6. Similar varieties and differences from these varieties

Please use the following table and box for comments to provide information on how your candidate variety differs from the variety (or varieties) which, to the best of your knowledge, is (or are) most similar. This information may help the examination authority to conduct its examination of distinctness in a more efficient way.

Denomination(s) of variety(ies) similar to your candidate variety	Characteristic(s) in which your candidate variety differs from the similar variety(ies)	Describe the expression of the characteristic(s) for the similar variety(ies)	Describe the expression of the characteristic(s) for your candidate variety
<i>Example</i>	<i>Fruit: length</i>	<i>long</i>	<i>very long</i>
Comments:			

TECHNICAL QUESTIONNAIRE	Page {x} of {y}	Reference Number:
-------------------------	-----------------	-------------------

#7.	Additional information which may help in the examination of the variety		
7.1	In addition to the information provided in sections 5 and 6, are there any additional characteristics which may help to distinguish the variety?		
	Yes	[]	No []
	(If yes, please provide details)		
7.2	Are there any special conditions for growing the variety or conducting the examination?		
	Yes	[]	No []
	(If yes, please provide details)		
7.3	Other information		
Special conditions for the examination of the variety			
	Main use		
	- Strictly ornamental use	[]	
	- Vegetable use	[]	
	- Rootstock	[]	

TECHNICAL QUESTIONNAIRE	Page {x} of {y}	Reference Number:
-------------------------	-----------------	-------------------

8. Authorization for release

- (a) Does the variety require prior authorization for release under legislation concerning the protection of the environment, human and animal health?

Yes ☐ No ☐

- (b) Has such authorization been obtained?

Yes ☐ No ☐

If the answer to (b) is yes, please attach a copy of the authorization.

9. Information on plant material to be examined or submitted for examination

9.1 The expression of a characteristic or several characteristics of a variety may be affected by factors, such as pests and disease, chemical treatment (e.g. growth retardants or pesticides), effects of tissue culture, different rootstocks, scions taken from different growth phases of a tree, etc.

9.2 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 the plant material has undergone such treatment, full details of the treatment must be given. In this respect, please indicate below, to the best of your knowledge, if the plant material to be examined has been subjected to:

- | | | |
|---|------------------------------|-----------------------------|
| (a) Microorganisms (e.g. virus, bacteria, phytoplasma) | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| (b) Chemical treatment (e.g. growth retardant, pesticide) | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| (c) Tissue culture | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| (d) Other factors | Yes <input type="checkbox"/> | No <input type="checkbox"/> |

Please provide details for where you have indicated "yes".

.....

10. I hereby declare that, to the best of my knowledge, the information provided in this form is correct:

Applicant's name

Signature

Date

[End of document]