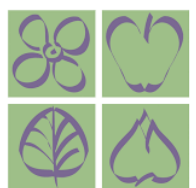


Final report

Strawberry Ring Test



CIOPORA



Bundessortenamt



December 2019

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Duration of the project: 4 years

CPVO subvention: 25 000€

The project was financed by the examination offices involved and the CPVO. The examination offices participating in the project took the costs of cultivation and the observations, whereas the CPVO paid for the delivery of the material and the meetings of project partners. The amount co-financed by the CPVO was estimated to amount to 25 000 EUR.

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Summary

In 2016-2019, the project partners reflected in the strawberry ring test co-financed by the CPVO, on the harmonization of the implementation of the protocol for strawberry and revision of characteristics of the current protocol as well as some additional characteristics. Through two-year growing study of 8 strawberry varieties and several meetings of the partners, a number of changes has been proposed as regards example varieties, characteristics, states of expression, methods of observations, scales and explanations. The growing trials showed that the variety description depended on the testing place and year, characteristic and available range of expression.

Introduction

Strawberry (*Fragaria x ananassa* Duchesne ex Rozier) is an important fruit crop in Europe and worldwide. The registration of new varieties of strawberry, either for Plant Breeders' Rights or National Listing (PBR/NL) purposes, requires the examination of distinctness, uniformity and stability (DUS). The number of candidate varieties entered for DUS testing is steadily increasing annually and it is the second most important fruit crop in number of CPVO applications.

The DUS testing of strawberry varieties is decentralised. There are four examination offices (EOs) entrusted by the Administrative Council of the CPVO.

Figure 1. Strawberry testing sites in the EU



Trials in Spain



Trials in Portugal



Trials in Poland



Trials in Germany

There are differences as to the way the testing is organised. The starting point of the DUS testing, i. e. the type of the material submitted, planting period differ from examination office to examination office as summarised in the Table 1 (situation in 2016).

Table 1: Submission requirements for 4 examination offices entrusted for strawberry.

Examination office	Cultivation type	Closing date	Submission start	Submission end	Plant quantity and quality
BSA	vegetative	31/05	01/07	31/07	30 vigorous, well-rooted, potted fresh plants, free from viruses, root rots and nematodes. The plants should be accompanied by a recognised certificate dating less than two months before the delivery of the plant material, indicating that the plant material is not affected by any important pest or disease, and has been lab-tested to give a negative result for: Arabis mosaic virus (ArMV) Strawberry crinkle virus (SCV) Strawberry mild yellow edge virus (SMYEV) Strawberry mottle virus (SMoV) Strawberry vein-banding virus (SVBV)
BSA	seed	15/10		15/12	1.5 g seed. Minimum germination capacity 60%
OEVV		31/08	10/10	25/10	40 well-rooted, vigorous, fresh plants. The quality of plants should not be less than the standards laid down in Council Directive 2000/29/EEC and 92/34/EEC and implementing measures
DGAV	fully remontan, day neutral	31/12	01/02	29/02	40 virus-tested plants packed in such a way as to prevent dehydration, and free from viruses, root rot or nematodes.
DGAV	non, partial, fully remontan	31/08	01/11	30/11	40 virus-tested plants packed in such a way as to prevent dehydration, and free from viruses, root rot and nematodes.
COBORU	vegetative	31/05	01/09	15/09	30 well-rooted, virus-tested plants. The plants should be accompanied by a recognised certificate indicating that the plant material is not affected by any important pest or disease, and has been lab-tested to give a negative result for: Strawberry mottle virus (SMV) Strawberry green petal (SGP-MLO)

The reference collections are maintained in different ways (in vitro, open field, greenhouse, seed store for seed propagated varieties).

The DUS testing is carried out on the same plants over two years, or plants propagated by the examination office or in each growing cycle on a new sample delivered by the applicant. It is done according to the CPVO Technical Protocol (TP) for strawberry of 2012.

It has become difficult in some cases to distinguish varieties. Some characteristics have been proposed and have been under investigation by the entrusted examination offices: Petiole: appendice petiolar, Appendice petiolar: length and Number of leaflets.

Objectives

The main objectives identified for the ring test were:

- a. The harmonization of the implementation of the protocol for strawberry. This includes:
 - ▶ The harmonisation of variety descriptions
 - ▶ Minimizing the room for individual interpretation for characteristic assessment
 - ▶ Standardization of the transformation of observations to notes – suitability of example varieties
 - ▶ Enhanced harmonisation of submission requirements
 - ▶ Verification if there should be a different test duration depending on type of bearing
 - ▶ Verification of suitability of the characteristic on number of leaflets for inclusion in the TP
 - ▶ Checking if one single growing (fruiting) period would be sufficient in order to establish DUS
- b. Review of the characteristics of the current protocol taking into account the following elements:
 - ▶ Variation of the expression with the environment
 - ▶ Discriminating power
 - ▶ Removal/addition of some characteristics from/to the protocol.

Material and methods

Varieties

A set of 8 varieties, widely known in the EU, was selected for the project based on the bearing type. The aim was to include 2 varieties per each bearing type (table 2).

Table 2. Summary of details on varieties selected for the project.

<i>Bearing type</i>	<i>Denomination</i>	<i>Holder of the right</i>	<i>Source</i>	<i>Official Variety Description (VD) for the Community right</i>
Not remontant	'Clery' (CL)	CIV	CIV	BSA
	'Gariguette' (G)	Bred by INRA, French PBR expired in 1998	CIV	-
Partially remontant	'Sweet Charlie' (S)	Florida Foundation Seed Producers Inc.	Angiers International (FR)	BSA
	'Camarosa' (CA)	The Regents University of California	CIV	OEVV
Fully remontant	'Albion'* (A)	The Regents University of California	COVIRO	DGAV
	'Murano' (M)	CIV	CIV	BSA
Day neutral	'Portola' (P)	The Regents University of California	COVIRO	DGAV
	'Everest' (E)	Edward Vinson Limited	Edward Vinson Limited	BSA

**in the official VD – fully remontant, experts report that it can be also day neutral*

The varieties were grown in a DUS trial design in the premises of the 4 partners of the project: BSA, COBORU, DGAV and OEVV.

Observations and analysis of outcome of growing trials

Observations were carried out over two growing cycles in 2017 and in 2018. The observations were made according to the CPVO Technical Protocol for strawberry (CPVO – TP 022/3 Final of 28 Nov 2012). All types of characteristics were assessed: qualitative (QL), quantitative (QN) and pseudo-qualitative (PQ).

In principle, the set of 48 characteristics was observed for each of the variety. However, in the following cases only one year data were subject to the analysis:

- 'Portola' in Spain,
- 'Sweet Charlie' in Portugal for characteristics 8, 13, 17 and 20 of the TP,
- 'Everest' – characteristics 6 and 7 in Germany,
- characteristic 30 for 'Camarosa', 'Albion', 'Murano', 'Everest' for Portugal.

In addition to the characteristics of the TP, 3 additional characteristics were observed (see table 3).

Table 3. Additional characteristics with corresponding states of expression, example varieties and notes.

	<i>Characteristics</i>	<i>Examples</i>	<i>Notes</i>
QL	Petiole: appendice petiolar		
	absent	Gorella, San Andreas, Ventana,	1
	present	Albion, Camarosa, Diamante	9
QN	Appendice petiolar: length		
	short	Portola, Seascape	3
	medium	Camarosa, Diamante, Spartan	5
	long	Albion, Benicia, Bonnaire	7
QN	Leaf: number of leaflets		
	always three	Mara des Bois	1
	three to four	Evi 2	2
	three to five	Everest	3

In total, over 3000 individual data were recorded and analysed in the project.

Based on the two-year results in each of the testing sites the following elements were analysed for each characteristic of the TP:

- the differences between combinations EO/ year for each variety
- the difference between the first and second growing cycle for each combination variety/testing site.

In the study, varieties showing the same performance over years/testing sites were considered good examples to be proposed for inclusion in the UPOV TG and the CPVO TP.

Characteristics for which in quantitative characteristics no difference or only one note difference was noted and qualitative characteristics without any difference in notes between observations in 2017 and 2018 at the same testing site were considered to be possibly the most useful for the DUS testing.

At the same time characteristics, exhibiting differences between observation in 2017 and 2018 in more than 4 cases (combinations variety/testing site) were considered less suitable for the DUS testing as being more influenced by environmental conditions.

Harmonisation of the implementation of the TP via direct exchanges

Four meetings of project partners took place. During the meetings, the participants exchanged on the way each individual characteristic is/should be observed. A number of comments in relation to the TP and suggestion for future revisions were formulated. Submission requirements and the trial design were discussed.

The following meetings of participants in the field took place:

- on 8 March 2017 in Spain,
- on 30 May 2017 in Portugal,
- on 6 June 2018 in Poland,
- on 7 June 2018 in Germany.

Results

Characteristics of the TP

Maximum difference for a given variety in notes between combinations EO/year

A complete set of TP characteristics was observed for each variety in 4 testing places over two growing cycles; 8 observations for each variety characteristic were compared and the maximum difference in notes was calculated.

Qualitative (QL) Characteristics

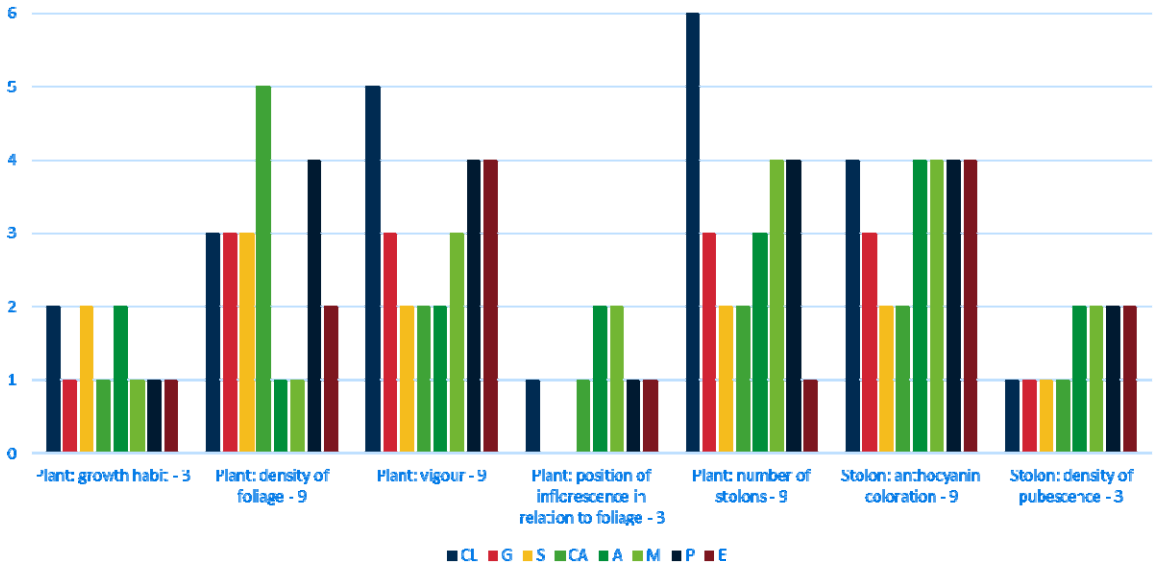
- In 2 QL characteristics, no any difference was noted:
- Leaf: variegation (it was always « absent »),
 - Flower: stamen (it was always « present »).

The lack of variation in these characteristics could not be considered as a lack of discriminating power (there were in the regular DUS testing varieties showing different states of expression), but was caused by the limited sample of varieties included in the project.

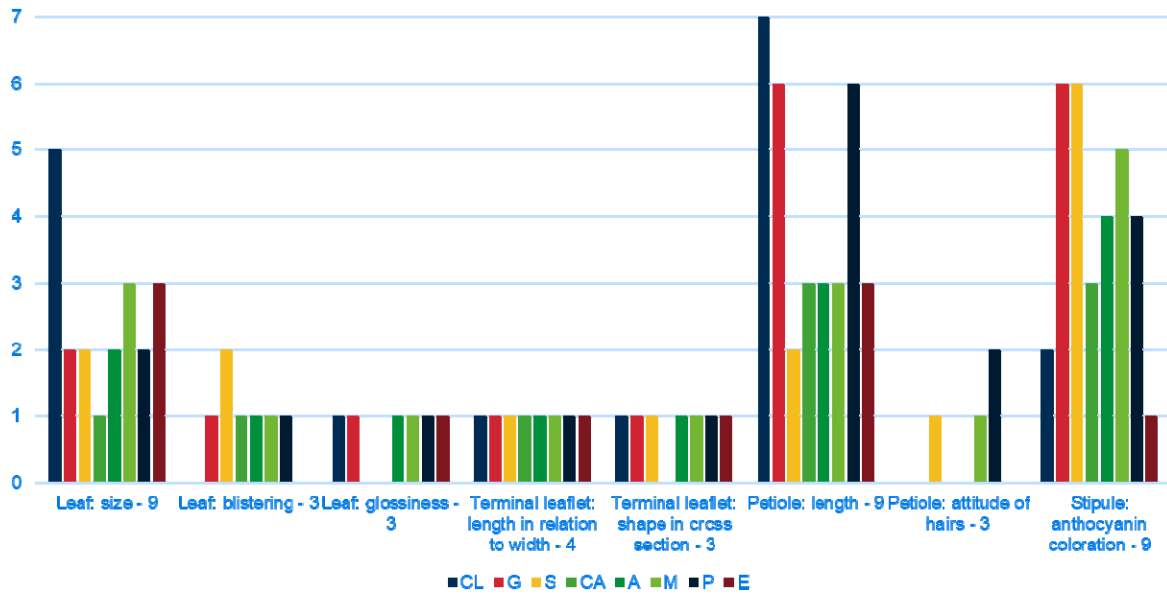
Quantitative (QN) Characteristics

In a great majority of cases, there was a difference in notes between combinations EO/year. The difference depended on characteristic, variety and the scale applicable to a given characteristics. Details of maximum difference recorded for QN characteristics are illustrated in graphs 1 – 4.

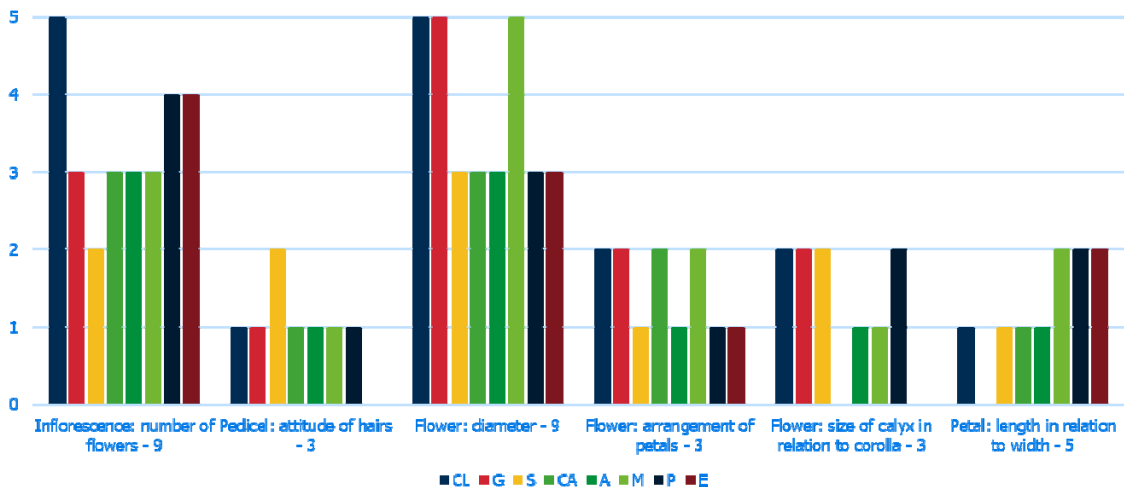
Graph 1. Maximum difference in notes between combinations EO/year for plant and stolon characteristics.



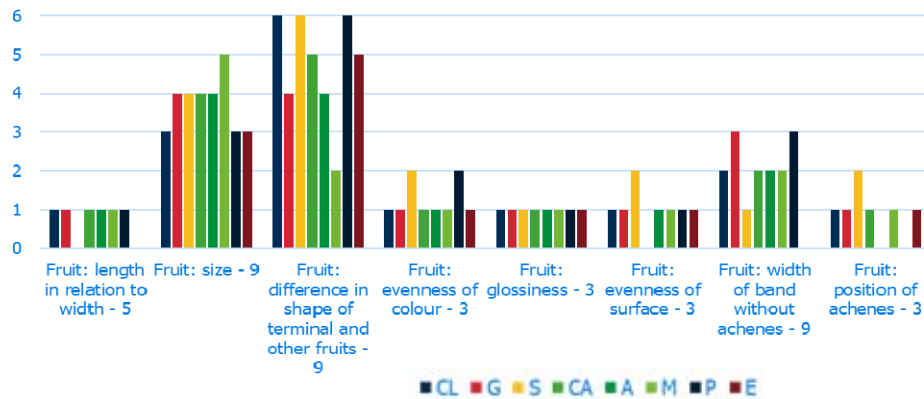
Graph 2. Maximum difference in notes between combinations EO/year for leaf characteristics.



Graph 3. Maximum difference in notes between combinations EO/year for flower characteristics.



Graph 4. Maximum difference in notes between combinations EO/year for fruit characteristics.



Examples:

- Plant: growth habit. The existing scale of notes is from 1 to 3. The maximum difference noted was of 2 notes for varieties 'Clery', 'Sweet Charlie' and 'Albion'. Although the difference might seem to be small, taking into account the available scale for each of the varieties the difference of 2 notes meant that depending on the testing site/year the whole range was used.
- Plant number of stolons. This characteristic is assessed using a 1-9 scale. The maximum differences noted for the variety: 'Clery' was of 6 notes, for varieties 'Gariguette' and 'Albion' was of 3 notes, for varieties 'Sweet Charlie' and 'Camarosa' was of 2 notes, for varieties 'Murano' and 'Portola' was of 4 notes and for variety 'Everest' was of 1 note.

Relatively low differences (of no more than 1 note) were noted for the following characteristics:

- Plant: glossiness (scale 1-3),
- Terminal leaflet length in relation to width (scale 1-4),
- Terminal leaflet: shape in cross section (scale 1-3),
- Fruit: length in relation to width (scale 1-5),
- Fruit: glossiness (scale 1-3).

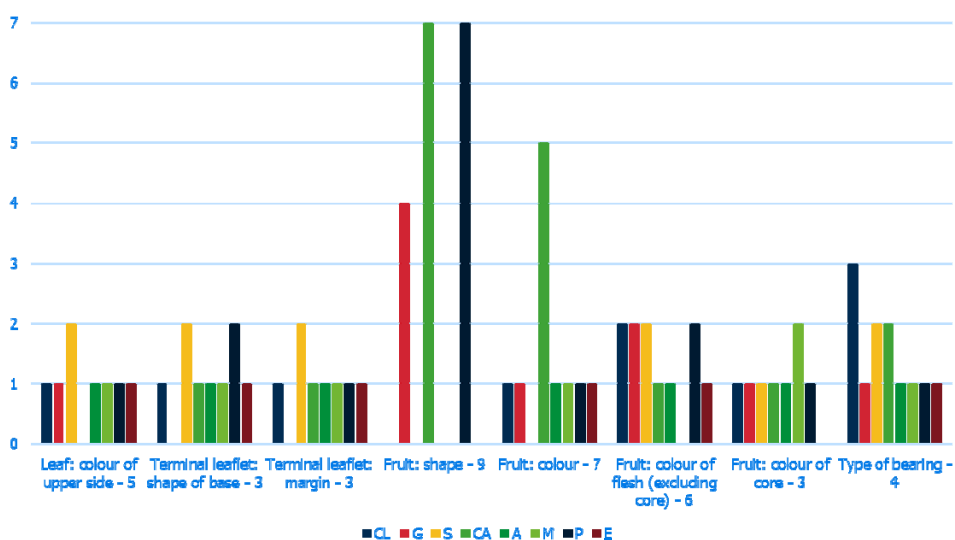
Pseudo-qualitative (PQ) Characteristics

In 1 PQ characteristic, no difference was noted:

- Petal: colour of upper side (it was always « white »).

A similar consideration was made as for the QL characteristics above.


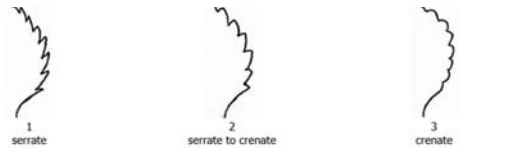
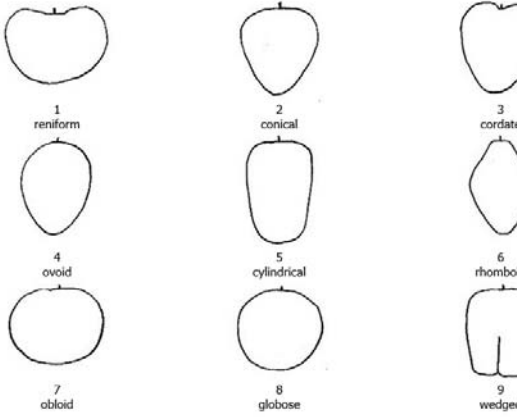
Graph 5. Maximum difference in notes between combinations EO/year for PQ characteristics.



The results of the observations showed that in most cases, for a given variety different states of expression were noted depending on the testing site and/or the growing cycle.

The difference in notes cannot be interpreted in the same way for PQ like for QN characteristics. Consequently, each difference needed to be looked at separately to investigate on the states of expressions which were attributed for a given characteristic to the same variety.

Table 4. Summary of observations for PQ characteristics.

<i>Characteristic</i>	<i>Available states of expression</i>	<i>Observations</i>
Leaf: colour of upper side	yellow green light green medium green dark green blue green	CL, G - light/medium green S - light/medium/dark green A, M, P, E - medium/dark green CA – medium green
Terminal leaflet: shape of base		CL, CA, E - acute/obtuse A, M - obtuse/rounded S, P - acute/obtuse/rounded G - acute
Terminal leaflet: margin		CL, M - serrate/serrate to crenate S - serrate/serrate to crenate/ crenate CA, A, P, E - serrate to crenate/ crenate G - serrate
Fruit: shape		CA - conical/cylindrical/wedged G - conical/cylindrical/rhomboid P – wedged/conical CL, S, M, A, E - conical
Fruit: colour	whitish yellow light orange medium orange orange red medium red dark red blackish red	CL, G, M, P - orange red/medium red CA - whitish yellow/medium red/dark red A, E - medium/dark red S – medium red
Fruit: colour of flesh	whitish light pink orange red light red medium red dark red	CL, G, S, P - light/medium/dark red CA, A, E - medium/dark red M – medium red
Fruit: colour of core	white light red medium red	CL, G, S, CA, A, P - light/medium red M - white/medium red E – medium red
Type of bearing	not remontant partially remontant fully remontant day neutral	CL - not/partially remontant/day neutral G, CA - not/partially remontant S - not/partially/fully remontant A, M, P, E - fully remontant/day neutral

The results showed that in some cases, the whole range of states of expression was used depending on the testing site and the growing cycle.

Examples:

- Terminal leaflet: shape of base – varieties: 'Sweet Charlie' and 'Portola' showed acute, obtuse or rounded shape,
- Terminal leaflet: margin – the variety 'Sweet Charlie' showed serrate, serrate to crenate or crenate margin.

Example varieties

In a number of cases, the same varieties showed consistently the same state of expression in both growing cycles and across the 4 testing sites. These varieties could be considered good examples for inclusion in the UPOV TG/CPVO TP. The table 5 provides summary of the varieties showing the same states of expression as mentioned above for both quantitative and pseudo-qualitative characteristics.

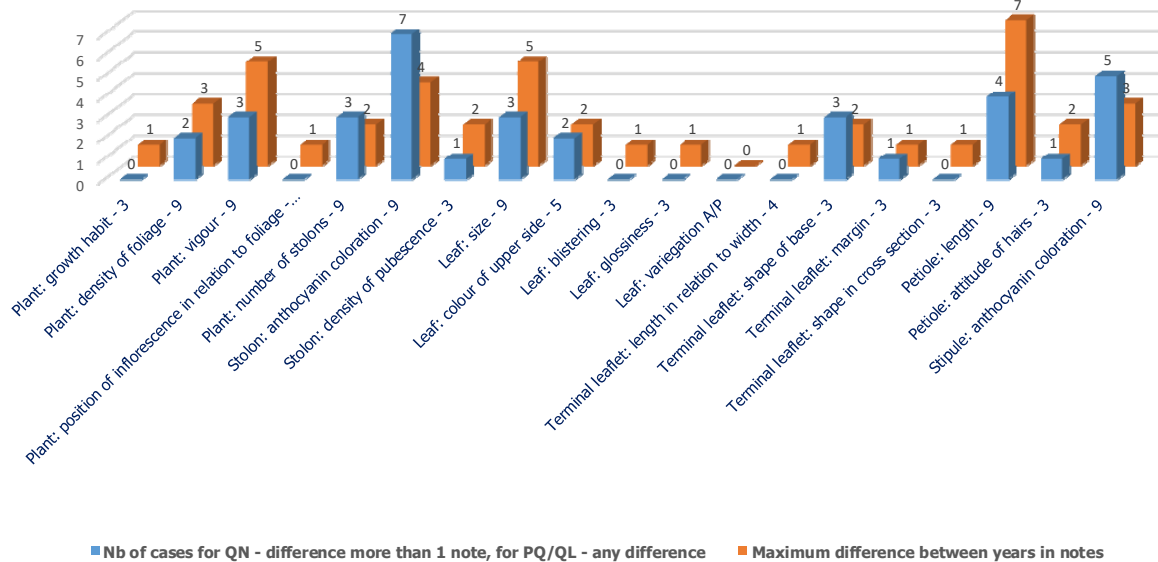
Table 5. Example varieties to be proposed to the UPOV TG/CPVO TP for given characteristics – states of expression/notes.

CPVO N°	Type	Characteristics	State of expression	Examples	Note
4.	QN	Plant: position of inflorescence in relation to foliage	same level	Gariguette, Sweet Charlie	2
9.	PQ	Leaf: colour of upper side	medium green	Camarosa	3
10.	QN	Leaf: blistering	absent or weak	Clery	1
			medium	Everest	2
11.	QN	Leaf: glossiness	medium	Sweet Charlie, Camarosa	2
14.	PQ	Terminal leaflet: shape of base	acute	Gariguette	1
15.	PQ	Terminal leaflet: margin	serrate	Gariguette	1
16.	QN	Terminal leaflet: shape in cross section	concave	Camarosa	1
18.	QN	Petiole: attitude of hairs	horizontal	Clery, Gariguette	3
21.	QN	Pedicele: attitude of hairs	slightly outwards	Everest	2
24.	QN	Flower: size of calyx in relation to corolla	larger	Camarosa, Everest	3
26.	QN	Petal: length in relation to width	moderately longer	Gariguette	4
28.	QN	Fruit: length in relation to width	equal	Everest	3
			moderately longer	Sweet Charlie	4
30.	PQ	Fruit: shape	conical	Albion, Clery, Everest, Murano, Sweet Charlie	2
32.	PQ	Fruit: colour	medium red	Sweet Charlie	5
35.	QN	Fruit: evenness of surface	slightly uneven	Camarosa	2
36.	QN	Fruit: width of band without achenes	narrow	Everest	3
37.	QN	Fruit: position of achenes	below surface	Albion, Portola	1
38.	QN	Fruit: position of calyx attachment	level with fruit	Murano, Sweet Charlie	2
			raised	Gariguette	3
43.	PQ	Fruit: colour of flesh (excluding core)	medium red	Murano	5
44.	PQ	Fruit: colour of core	medium red	Everest	3

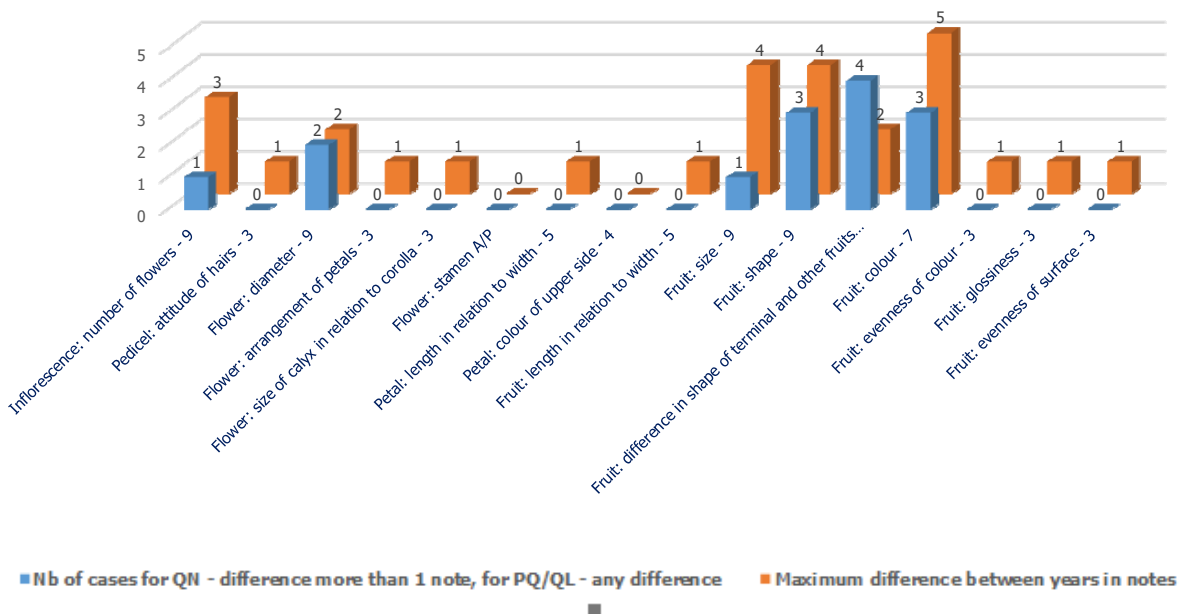
Difference in notes for combinations variety/testing place between 1st and 2nd growing cycle

For each characteristic 8 varieties of the project were assessed in 4 testing sites. The results obtained in one growing cycle were compared with the results obtained for the same variety and the same characteristic in the second cycle; the difference in notes was calculated. The maximum differences noted and the number of cases with differences are illustrated in the graphs 6 – 8.

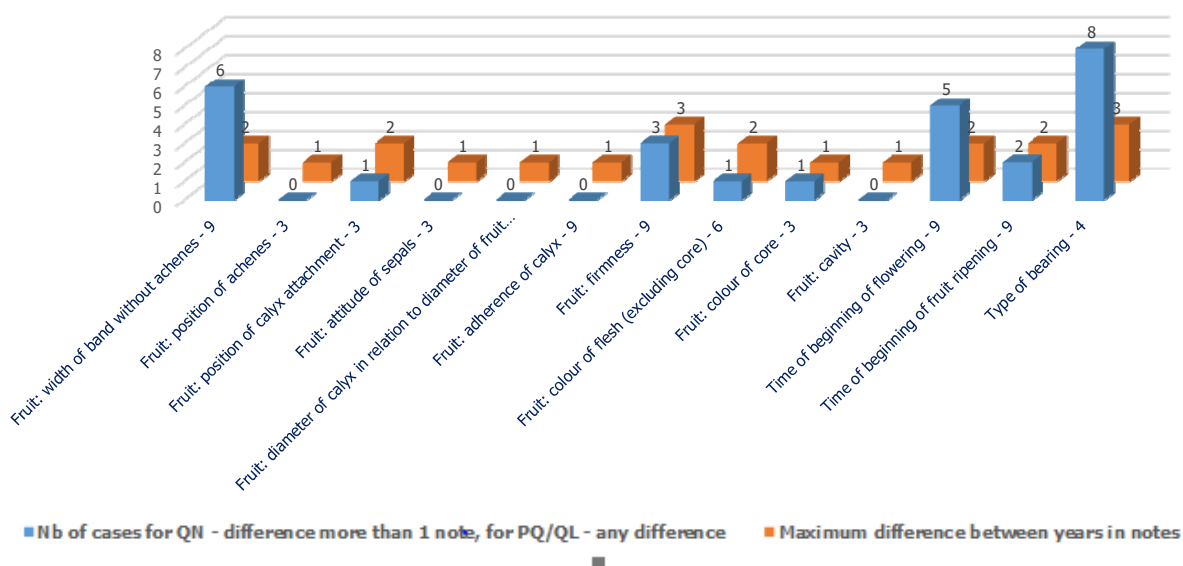
Graph 6. Difference in notes between 1st and 2nd growing cycles for characteristics 1 – 19 of the TP.



Graph 7. Difference in notes between 1st and 2nd growing cycles for characteristics 20 - 33 of the TP.



Graph 8. Difference in notes between 1st and 2nd growing cycles for characteristics 34 - 48 of the TP.



For QN characteristics, it was assumed that a characteristic could be suitable for DUS testing if no difference or a difference of only one note was observed; in case a bigger difference than of one note was noted in more than four cases (combinations of the testing site/variety) then it would mean that the characteristic might be more disposed to year effect at the same testing site.

For PQ and QL characteristics, it was assumed that those without any difference in notes could be suitable in the DUS testing whereas those showing any difference, could be more prone to environmental influence.

The list of characteristics for which very little or no difference between 1st and 2nd growing cycles was noted:

- Plant: growth habit
- Plant: position of inflorescence in relation to foliage
- Leaf: blistering
- Leaf: glossiness
- Leaf: variegation
- Terminal leaflet: length in relation to width
- Terminal leaflet: shape in cross section
- Pedicel: attitude of hairs
- Flower: arrangement of petals
- Flower: size of calyx in relation to corolla
- Flower: stamen
- Petal: length in relation to width
- Petal: colour of upper side
- Fruit: length in relation to width
- Fruit: evenness of colour
- Fruit: glossiness
- Fruit: evenness of surface
- Fruit: position of achenes
- Fruit: attitude of sepals
- Fruit: diameter of calyx in relation to diameter of fruit
- Fruit: adherence of calyx
- Fruit: cavity.

List of characteristics for which a difference between the 1st and 2nd growing cycle for at least 4 combinations of varieties/testing sites was noted:

- Stolon: anthocyanin coloration
- Petiole: length
- Stipule: anthocyanin coloration
- Fruit: difference in shape of terminal and other fruits
- Fruit: width of band without achenes
- Time of beginning of flowering
- Type of bearing.

Assessment of time of beginning of flowering

Two interpretations of the characteristics were reported by experts:

- time when at least 50% of plants have at least one flower,
- time when 10% of flowers are open.

COBORU compared two ways of observation during one growing cycle. There was no difference on level of notes when using one or the other way of observing, but there was a difference of 4 days in the start of flowering. The experts agreed that some explanation on the way of observation to be applied in the DUS testing should be added in the UPOV TG/CPVO TP.

Additional Characteristics

The examiners evaluated the varieties for the additional characteristics (see table 3):

- Petiole: appendice petiolar,
- Appendice petiolar: length,
- Leaf: number of leaflets.

As to the appendice petiolar, 'Clery' – ca. 50% of plants showed presence of the appendice with the size "medium", the variety 'Gariguette' also showed some appendices petiolar, but not the variety 'Sweet Charlie'. It was noted that not all the plants of the same variety produce appendices at the same testing site and in the same cycle. This characteristic did not meet the UPOV requirements as to the uniformity criterion; it seemed to be too strongly influenced by environment in order to be included in the TP.

As to the number of leaflets, the variety 'Everest' did not show the expression as proposed (example variety for the state: "three to five"). For example in Spain, it produced 3 leaflets only. Different plants showed different expressions at the same testing site and hence the uniformity criterion could not be met. In addition, the variety 'Everest' did not seem to be suited to the conditions of the Spanish testing station.

The group proposed to consider for the purpose of the revision of the UPOV TG two additional characteristics:

- density of achenes; the characteristic was illustrated with different states of expression by Bundessortenamt,
- inflorescence: length.

Harmonisation of the implementation of the TP via direct exchanges

In the course of the project, 4 meetings in the field were organised. During the meetings, the project partners exchanged among others on the trial design, ways of observation, example varieties, usefulness of characteristic and states of expression.

Characteristics of the TP

Numerous recommendations for consideration when revising UPOV TG/CPVO TP were made. The columns "Method" and "Remarks" of the Table 6 summarise the recommendations made by the participants for majority of the characteristics of the current TP.

Table 6. Summary of methods of observations and remarks made by participants to the project.

Characteristic of the TP			Scale	Method	Remarks
1.	QN	Plant: growth habit	1-3	VG	The scale is adapted. Proposals for example varieties: 1 – 'Camarosa' 2 – 'Primoris', 'Albion' 3 – 'Splendor', 'Selva', 'Irvine' It can be difficult to assess due to possible different behaviour of the same variety as confirmed in the project.
2.	QN	Plant: density of foliage	1-9	VG	The scale may need reduction.
3.	QN	Plant: vigour	1-9	VG	The scale may need reduction.
8.	QN	Leaf: size	1-9	See the next column	The scale may need reduction. Example varieties: 'Everest' seems not be small but rather medium 'Pink Panda' and 'Portola' could be used for small' 'Korona' for medium; 'Ventana' for large. Some experts assessed it visually assessed, some measured; it was clarified that the characteristic as defined in the TP is intended for visual observation although measurements may be performed to support the visual assessment.
9.	PQ	Leaf: colour of upper side	1-5	VG	The scale is adapted. Sometimes colour catalogue is used.
10.	QN	Leaf: blistering	1-3	VG	No particular comments
11.	QN	Leaf: glossiness	1-3	VG	Proposals for example varieties: 1 – 'Ventana' 3 – 'Florence' and 'Malwina' Different interpretation of the characteristics has been identified: some experts assess it with the wax or after removal of wax.
12.	QL	Leaf: variegation	1,9	VG	Proposal to delete the characteristic.
13.	QN	Terminal leaflet: length in relation to width	1-4	MG/VG	It should be checked if 'Gariguette' should be for note 3 or 4.
14.	PQ	Terminal leaflet: shape of base	1-3	VG	No particular comments were made.
15.	PQ	Terminal leaflet: margin	1-3	VG	Different expressions for the same variety were noted, some experts considered that this was due to different environmental influences.
16.	QN	Terminal leaflet: shape in cross section	1-3	VG	No particular comments were made.
17.	QN	Petiole: length	1-9	MG/VG	No particular comments were made.
18.	QN	Petiole: attitude of hairs	1-3	VG	The state of expression downwards with the note 4 should be added.
19.	QN	Stipule: anthocyanin coloration	1-9	VG	Experts propose to reduce scale to 1-5.
21.	QN	Pedicele: attitude of hairs	1-3	VG	The state of expression downwards with the note 4 should be added.
22.	QN	Flower: diameter	1-9	VG/MG	No particular comments were made.
23.	QN	Flower: arrangement of petals	1-3	VG	No particular comments were made.
25.	QL	Flower: stamen	1,9	VG	Although no variation noted for varieties in the ring test, there are some varieties without stamens and hence the characteristic should be kept.
26.	QN	Petal: length in relation to width	1-5	VG/MG	No particular comments were made.
29.	QN	Fruit: size	1-9	VG/MG	Some experts measure length and width, some do visual assessment; might need explanation; if MG is excluded as the method could help to interpret the characteristic (only visual overall size without dividing it into length, width, thickness). In some cases, measurements are used to support the visual observations.
30.	PQ	Fruit: shape	1-9	VG	A grid could be helpful; 3-D picture instead of 2-D in particular to understand the difference between cylindrical and wedged states. Proposals for example varieties: rhomboid – 'Ambrosia' wedged – 'Camarosa'

Characteristic of the TP		Scale	Method	Remarks	
				Proposal to split to shape of apex, shape of base, position of widest part.	
31.	QN	Fruit: difference in shape of terminal and other fruits	1-9	VG	<p>It is difficult to assess this characteristic; it needs explanation or might be replaced by 2 characteristics: 1 – shape of the terminal fruit 2 – shape of the other fruit.</p> <p>It is not assessable by comparing terminal fruit with secondary ones, only, but needs paying attention to misshapen fruits, which are likely to occur in terminal fruits, and which therefore cannot always refer to regular shapes as presented in characteristic 30.</p> <p>After discussion on a possible renaming of the characteristic (regularity of shape or evenness of shape) some experts proposed to delete the characteristics, but some were in favour to keep it. There are varieties where there is no difference between the terminal and other fruits. Breeders aim at varieties without the difference; one expert remarked that this characteristic was not used so far to declare varieties distinct, and will possibly be used only in very clear cases.</p>
32.	PQ	Fruit: colour	1-7	VG	<p>Some explanation should be added; different colours can be observed for the same fruit; there are some bicolor varieties. Some experts evaluate the overall impression of the colour, some point to the need to see on the sunny side. The assessment for the same fruit of 'Gariguette' showed that some experts tended to assess it as medium orange some as medium red or even dark red.</p> <p>It could be considered if 2 characteristics should be instead: 1 – colour on sunny side (some experts in favour to keep only this option) 2 – colour on shaded side Proposal to add states: whitish pink, whitish orange, light red. Example variety used in the TP 'Weisse Ananas' is not whitish yellow.</p>
33.	QN	Fruit: evenness of colour	1-3	VG	Explanation should be added; different colours can be observed for the same fruit; the explanation should clarify also which colour should be taken into account in case of uneven colouring.
36.	QN	Fruit: width of band without achenes	1-9	No decision	Some experts proposed to reduce scale to 1-5, some in favour to keep the 1-9 scale.
41.	QN	Fruit: adherence of calyx	1-9	No decision	To reduce scale to 1-5.
42.	QN	Fruit: firmness	1-9	VG/MG	Some experts proposed to reduce scale to 1-5, some in favour to keep the 1-9 scale.
43.	PQ	Fruit: colour of flesh (excluding core)	1-6	VG	Different expressions for the same variety in the first year of observations could be attributed at least partly to different perception of colours by experts (especially as regards states: orange red, light red and medium red) and hence it is good to keep examples for this PQ characteristic for calibration purposes, even though colours are considered to be self-explanatory.
44.	PQ	Fruit: colour of core	1-3	VG	Experts proposed to add note 4 – dark red.
46.	QN	Time of beginning of flowering	1-9	VG/MG	In the project two ways of observation were compared: no difference on level of notes was noted although 4 days difference in the start of flowering; some experts proposed to add explanation "Time when 50% of plants have at least one flower open", some expressed the wish to harmonise the interpretation of the characteristic with other crops and define the characteristic as "time when all plants have 10% of flower open".
47.	QN	Time of beginning of fruit ripening	1-9	VG/MG	It was suggested that a similar interpretation as for beginning of flowering could be applied.
48.	PQ	Type of bearing	1-4	VG	<p>A proposal to replace this characteristic by 2 characteristics has been formulated: 1. about the plant whether it is remontant or not 2. whether there are flowering stolons or not.</p> <p>In Spain, due to the particular growing conditions the characteristic could not be observe as intended by the current wording. However, in case the same plants were kept over two growing periods in Portugal the existing scale could be observed.</p>

Changes to submission requirements

During the meetings, the participants considered the possibility of further harmonisation of submission requirements. Some changes were proposed, accepted and later on implemented in the S2 Publication of the CPVO (Table 7).

Table 7. Submission requirements for strawberry in the S2 Publication.

<i>EO</i>	<i>Cultivation type</i>	<i>Quantity Quality</i>
BSA	vegetatively propagated	30 plants, potted, well rooted, this year's plants. The plants should be accompanied by a Plant Passport or a Phytosanitary Certificate and a recognised certificate dating less than two months before the delivery of the plant material, indicating that the plant material has been lab-tested to give a negative result for: - Strawberry Crinkle Virus (SCV) [PCR] - Strawberry Mottle Virus (SMV) [PCR] - Arabis Mosaic Virus (ArMV) [ELISA] - Strawberry Mild Yellow Edge Virus (SMYEV) [PCR].
BSA	seed propagated	1.5 g seeds, minimum germination capacity 60%.
OEVV	vegetatively propagated	40 well rooted, vigorous, this year plants. Plant material will be sent each year for two consecutive years. The plant material of the candidate and the reference varieties should be accompanied by a Plant Passport or Phytosanitary Certificate and a recognised certificate dating less than two months before the delivery of the plant material, indicating that the plant material has been lab-tested by PCR with a negative result for: - Arabic mosaic virus (ArMV) - Strawberry crinkle cytorhabdovirus (SCrV) - Strawberry mild yellow edge virus (SMYEV) - Strawberry mottle virus (SMoV) - Strawberry vein banding virus
OEVV	seed propagated	1.5 g seeds, minimum germination capacity 60%.
DGAV	non, partial, fully remontant	40 plants, packed in such a way as to prevent dehydration. The plants should be accompanied by a Plant Passport or a Phytosanitary Certificate.
DGAV	fully remontant, day neutral	40 plants, packed in such a way as to prevent dehydration. The plants should be accompanied by a Plant Passport or a Phytosanitary Certificate.
COBORU	vegetatively propagated	30 plants, well rooted. The plants should be accompanied by a Plant Passport or a Phytosanitary Certificate and a recognised certificate dating less than two months before the delivery of the plant material, indicating that the plant material has been lab-tested to give a negative result for: - Strawberry green petal (SGP-MLO) [PCR] - Strawberry Mottle Virus (SMV) [PCR].

Breeders reported that quality of the material delivered for testing may affect a number of characteristics like flowering time, number of flowers, some fruit characteristics; as a consequence further standardisation of plant material used for the DUS testing would be desirable.

Duration of the test

The partners agreed that the duration of the test should be of two growing cycles. In particular, the first growing cycle is used to adjust the selection of similar varieties. The breeding works in the crop are very intensive and the

varieties are getting closer and closer. The description in the TQ provides only limited information and is based on plants grown under different conditions than those of the testing station. The results of the ring test also confirm that the growing conditions affect the variety description in most of the characteristics, also those used for grouping like bearing type. The results of the DUS assessment in the first growing cycle are used to review the selection of varieties for direct comparison in the second cycle.

Conclusions

The expression of a great majority of characteristics of the currently used TP for a given variety strongly depended on the testing site, the characteristic in question and the range of expression.

The ring test proved that the harmonisation of the variety description has limitations, in particular linked to the testing conditions. These limitations need to be taken into account when using the variety description for different purposes.

The differences between the observation in the 1st and 2nd growing cycle for the same variety in a given testing site were smaller than between the different testing sites.

No any difference was noted for 3 characteristics (2 QL + 1 PQ) - Leaf: variegation, Flower: stamen and Petal: colour.

The 3 additional characteristics studied in the project do not meet the UPOV requirements for use in the DUS testing.

Numerous recommendations as regards the revision of the UPOV TG/CPVO TP concerning the method of observation, example varieties, states of expression, interpretation of characteristics have been made by the experts and are summarised in the tables 5 and 6. The recommendations made reflect in particular points where different interpretations were noted and/or the group considered that more precise data should be provided. They aim at more harmonised implementation of the TG/TP.

The project confirmed that a ring test is a very useful tool in order to raise awareness of differences in interpretation of individual characteristics, reasons for the differences, to enhanced harmonisation of the DUS testing, as well as to elaborate on the revision of the UPOV TG/CPVO TP.

Follow up

The Strawberry Ring Test was presented at UPOV TWF meeting of 2018 in Chile in order to trigger the revision of the respective UPOV TG. The revision is led by the German expert participating in the R&D project and the results of the projects are currently being used in the works on the revision. Once the UPOV TG is revised, the CPVO TP will be modified.