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TC-EDC/Jan14/2
ORIGINAL: English
DATE: December 13, 2013

INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS

Geneva

ENLARGED EDITORIAL COMMITTEE

Geneva, January 8 and 9, 2014

TGP DOCUMENTS

Document prepared by the Office of the Union

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1. The purpose of this document is to provide an overview of developments concerning TGP documents.

2. The following abbreviations are used in this document:

CAJ:	Administrative and Legal Committee
TC:	Technical Committee
TC-EDC:	Enlarged Editorial Committee
TWA:	Technical Working Party for Agricultural Crops
TWC:	Technical Working Party on Automation and Computer Programs
TWF:	Technical Working Party for Fruit Crops
TWO:	Technical Working Party for Ornamental Plants and Forest Trees
TWV:	Technical Working Party for Vegetables
TWPs:	Technical Working Parties

3. The structure of this document is as follows:

I. BACKGROUND

4. The purpose of document TG/1/3 "General Introduction to the Examination of Distinctness, Uniformity and Stability and the Development of Harmonized Descriptions of New Varieties of Plants" (General Introduction), and the associated series of documents specifying Test Guidelines' Procedures (TGP documents), is to set out the principles which are used in the examination of DUS. The only binding obligations for members of the Union are those contained in the UPOV Convention itself. However, on the basis of practical experience, the General Introduction and the TGP documents seek to provide general guidance for the examination of all species in accordance with the UPOV Convention. In addition, UPOV has developed "Guidelines for the Conduct of Tests for Distinctness, Uniformity and Stability" (Test Guidelines), for many individual species or other variety groupings. The purpose of those Test Guidelines is to elaborate certain of the principles contained in the General Introduction and the associated TGP documents, into detailed practical guidance for the harmonized examination of DUS and, in particular, to identify appropriate characteristics for the examination of DUS and production of harmonized variety descriptions.

5. As noted by the Chair at the fifty-fourth session of the Administrative and Legal Committee (CAJ), held in Geneva on October 16 and 17, 2006, the development of TGP documents in relation to the DUS examination may be seen as another element in the preparation of information materials concerning the UPOV Convention[1] and, in addition to being published in their own right, the TGP documents can be used in support of various UPOV activities. In particular, the General Introduction and the TGP documents will form the basis of an advanced module on "Examination of Applications for Plant Breeders' Rights" for inclusion in the Distance Learning program, which the Consultative Committee has entrusted the Office of the Union to develop.

6. The situation with regard to the development of TGP documents can be summarized as follows:

Document reference	**Issue**	**Title**	**Issue date**
TGP/0	/6	List of TGP Documents and Latest Issue Dates	October 24, 2013
TGP/1		General Introduction With Explanations	not yet issued
TGP/2	/1	List of Test Guidelines Adopted by UPOV	April 6, 2005
TGP/3		Varieties of Common Knowledge	not yet issued[2]
TGP/4	/1	Constitution and Maintenance of Variety Collections	April 11, 2008
TGP/5		Experience and Cooperation in DUS Testing	
Introduction		Introduction	October 30, 2008
Section 1	/2	Model Administrative Agreement for International Cooperation in the Testing of Varieties	October 30, 2008
Section 2	/3	UPOV Model Form for the Application for Plant Breeders' Rights	October 21, 2010
Section 3	/1	Technical Questionnaire to be Completed in Connection with an Application for Plant Breeders' Rights	April 6, 2005
S ection 4	/2	UPOV Model Form for the Designation of the Sample of the Variety	October 30, 2008

[1] The CAJ, at its fifty-second session, held in Geneva on October 24, 2005, agreed an approach for the preparation of information materials concerning the UPOV Convention, as explained in paragraphs 8 to 10 of document CAJ/52/4. It also agreed the establishment of an advisory group to the CAJ ("CAJ-AG") to assist in the preparation of documents concerning such materials, as proposed in paragraphs 11 to 14 of document CAJ/52/4 (see paragraph 67 of document CAJ/52/5, Report).

[2] At its fifty-fifth session, held in Geneva on March 29, 2007, "[t]he CAJ endorsed the conclusion of the CAJ-AG that the General Introduction already provided guidance with respect to the term 'common knowledge' and that it would not be appropriate, for the time being, to pursue the development of document TGP/3 'Varieties of Common Knowledge'." (see document CAJ/55/7, paragraph 46).

Document reference	Issue	Title	Issue date
Section 5	/2	UPOV Request for Examination Results and UPOV Answer to the Request for Examination Results	October 30, 2008
Section 6	/2	UPOV Report on Technical Examination and UPOV Variety Description	October 30, 2008
Section 7	/2	UPOV Interim Report on Technical Examination	October 30, 2008
Section 8	/1	Cooperation in Examination	April 6, 2005
Section 9	/1	List of Species in Which Practical Knowledge has Been Acquired or for Which National Test Guidelines Have Been Established	April 6, 2005
Section 10	/2	Notification of Additional Characteristics	October 20, 2011
Section 11	/1	Examples of Policies and Contracts for Material Submitted by the Breeder	October 30, 2008
TGP/6	/1	Arrangements for DUS Testing	
Section 1	/1	Introduction	April 6, 2005
Section 2	/1	Examples of Arrangements for DUS Testing	April 6, 2005
Section 3	/1	Declaration on the Conditions for the Examination of a Variety Based on Trials Carried Out by or on behalf of the Breeder	April 6, 2005
TGP/7	/3	Development of Test Guidelines	October 20, 2011
TGP/8	/1	Trial Design and Techniques Used in the Examination of Distinctness, Uniformity and Stability	October 21, 2010
TGP/9	/1	Examining Distinctness	April 11, 2008
TGP/10	/1	Examining Uniformity	October 30, 2008
TGP/11	/1	Examining Stability	October 20, 2011
TGP/12	/2	Guidance on Certain Physiological Characteristics	November 1, 2012
TGP/13	/1	Guidance for New Types and Species	October 22, 2009
TGP/14	/2	Glossary of Terms Used in UPOV Documents	October 24, 2013
TGP/15	/1	Guidance on the Use of Biochemical and Molecular Markers in the Examination of Distinctness, Uniformity and Stability (DUS)	October 24, 2013

The General Introduction, approved TGP documents and adopted Test Guidelines are published on the UPOV website at http://www.upov.int/upov_collection/en/

II. TGP DOCUMENTS FOR ADOPTION IN 2014

7. The TC, at its forty-ninth session, and the CAJ, at its sixty-seventh session, approved the program for the development of TGP documents, as set out in the Annex to documents TC/49/5 and CAJ/67/3, respectively (see document TC/49/41 “Report on the Conclusions”, paragraph 87, and document CAJ/67/14 “Report on the Conclusions”, paragraph 39, respectively).

8. Subject to approval by the TC and the CAJ, the following revisions of TGP documents will be put forward for adoption by the Council at its forty-eighth ordinary session, to be held in Geneva on October 16, 2014:

TGP/0: List of TGP Documents and Latest Issue Dates

9. Document TGP/0/6, adopted by the Council at its forty-seventh session, held on October 24, 2013, will need to be updated (to become document TGP/0/7) to reflect any adoptions or revisions of TGP documents by the Council at its forty-eighth session.

TGP/2: List of Test Guidelines Adopted by UPOV

10. Document TGP/2: List of Test Guidelines Adopted by UPOV currently states that:

> "A list and copies of adopted and published Test Guidelines can be obtained at http://www.upov.int/en/publications/tg-rom/tg_index.htm".

11. It is necessary to update document TGP/2 to read as follows:

> "A list and copies of adopted and published Test Guidelines can be obtained at ~~http://www.upov.int/en/publications/tg-rom/tg_index.htm~~ http://www.upov.int/test_guidelines/en/".

TGP/5: Experience and Cooperation in DUS Testing: Section 10: Notification of Additional Characteristics

(i) *Revision of document TGP/5 Section 10: "Notification of Additional Characteristics and States of Expression"*

The proposed revision is presented in document TC-EDC/Jan14/3.

TGP/7: Development of Test Guidelines

12. Annex I to this document contains the revisions already agreed by the TC for document TGP/7 "Development of Test Guidelines".

13. The following proposals for revision of document TGP/7 will be considered on the basis of the indicated documents:

(i) *Revision of document TGP/7: Additional Standard Wording for Growing Cycle for Tropical Species;*

See document TC-EDC/Jan14/4.

(ii) *Revision of document TGP/7: Indication of Growth Stage in Test Guidelines;*

See document TC-EDC/Jan14/6.

(iii) *Revision of document TGP/7: Providing Illustrations of Color in Test Guidelines;*

See document TC-EDC/Jan14/7.

(iv) *Revision of document TGP/7: Presence of Leading Expert at Technical Working Party Sessions;*

See document TC-EDC/Jan14/8.

TGP/8: Trial Design and Techniques Used in the Examination of Distinctness, Uniformity and Stability

14. Annex II to this document contains the revisions already agreed by the TC for document TGP/8 "Trial Design and Techniques Used in the Examination of Distinctness, Uniformity and Stability".

15. The following proposals for revision of document TGP/8 will be considered on the basis of the indicated documents:

(i) *Revision of document TGP/8: Part II: New Section 10: Minimum Number of Comparable Varieties for the Relative Variance Method;*

See document TC-EDC/Jan14/11.

(ii) *Revision of document TGP/8: Part II: New Section 11: Examining DUS in Bulk Samples;*

See document TC-EDC/Jan14/12.

TGP/9: Examining Distinctness

16. Annex III to this document contains the revisions already agreed by the TC for document TGP/9 "Examining Distinctness".

TGP/14: Glossary of Terms Used in UPOV Documents – Correction (Spanish)

17. A correction to the explanation of predominant color is required in the Spanish version of document TGP/14: Section 2: Subsection 3: Color, paragraph 2.2.2 (a) as follows:

"a) En combinaciones de colores, el ~~segundo~~ primer color indica el color predominante […]"

III. FUTURE REVISION OF TGP DOCUMENTS

18. The following revisions of TGP documents will be considered by the TC:

TGP/7: Development of Test Guidelines

(i) *Revision of document TGP/7: Source of Propagating material;*

See document TC-EDC/Jan14/5.

(ii) *Revision of document TGP/7: Drafter's Kit for Test Guidelines;*

19. Subject to the introduction of the new electronic Test Guidelines template in 2014, a revision of document TGP/7 will be required in relation to Section 4.3: "Drafter's Kit for Test Guidelines" and Annex 4 "Collection of Approved Characteristics".

TGP/8: Trial Design and Techniques Used in the Examination of Distinctness, Uniformity and Stability

20. The following matters will be discussed on the basis of the indicated documents:

(i) *Revision of document TGP/8: Part I: New Section: Minimizing the Variation due to Different Observers;*

See document TC-EDC/Jan14/9.

(ii) *Revision of document TGP/8: Part II: Method of Calculation of COYU;*

See document TC-EDC/Jan14/10.

(iii) *Revision of document TGP/8: Part II: New Section: Data Processing for the Assessment of Distinctness and for Producing Variety Descriptions;*

See document TC-EDC/Jan14/13.

(iv) *Revision of document TGP/8: Part II: New Section: Guidance of Data Analysis for Blind Randomized Trials;*

See document TC-EDC/Jan14/14.

(v) *Revision of document TGP/8: Part II: New Section: Examining Characteristics Using Image Analysis;*

See document TC-EDC/Jan14/15.

(vi) *Revision of document TGP/8: Part II: New Section: Statistical Methods for Visually Observed Characteristics;*

See document TC-EDC/Jan14/16.

TGP/14: Glossary of Terms Used in UPOV Documents

(i) *Revision of document TGP/14: Section 2: Botanical Terms, Subsection 3: Color: Definition for "Dot".*

See document TC-EDC/Jan14/17.

IV. PROGRAM FOR THE DEVELOPMENT OF TGP DOCUMENTS

21. Annex IV to this document proposes a program for the development of TGP documents on the basis of the conclusions by the TC, as its forty-ninth session, and the CAJ, at its sixty-seventh session (see document TC/49/41 "Report on the Conclusions", paragraph 87, and document CAJ/67/14 "Report on the Conclusions", paragraph 39, respectively).

22. The linguistic experts of the TC-EDC are requested to check the French, German and Spanish translation of the Annexes to this document by February 14, 2014.

23. The TC-EDC is invited to note the information in this document to be presented to the TC and propose any improvements to the document in that regard.

[Annexes follow]

ANNEX I

REVISION OF DOCUMENT TGP/7: MATTERS APPROVED BY THE TC

TABLE OF CONTENTS

SECTION 2: PROCEDURE FOR THE INTRODUCTION AND REVISION OF UPOV TEST GUIDELINES

Procedure for the Development of Test Guidelines

To replace current Section 2.2.3.2 as follows (see document TC/48/22 “Report on the Conclusions”, paragraph 48):

> “2.2.3.2 In cases where more than one TWP has proposed the development of Test Guidelines with the same coverage, the Technical Committee will decide which TWP should be responsible for the drafting of the Test Guidelines and which other TWPs should cooperate. This will be decided on the basis of the level of experience in the TWPs concerned. In such cases, the Technical Committee will request the approval of other cooperating TWPs before a draft is submitted for adoption.”

ANNEX 2: ADDITIONAL STANDARD WORDING (ASW) FOR THE TG TEMPLATE

ASW 0 (New): Coverage of Types of Varieties in Test Guidelines

To add new ASW as follows (see document TC/47/26 “Report on the Conclusions”, paragraph 54):

> “ASW 0 (TG Template: Chapter 1.1) – Coverage of types of varieties in Test Guidelines
>
> “Where appropriate, the following ASW may be included in Chapter 1.1. Such wording should not lead to any particular conclusions as to whether other types of varieties should or should not be covered by the development of separate Test Guidelines, since that would need to be considered on a case-by-case basis.
>
> > “In the case of [ornamental] [fruit] [industrial] [vegetable] [agricultural] [etc.] 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.”

Consequential changes:

To insert in Annex I: Chapter 1 “Subject of these Test Guidelines”:

> “{ASW 0 (Chapter 1.1) – coverage of types of varieties in Test Guidelines}”

ASW 16: Providing Photographs with the Technical Questionnaire

To replace ASW 16 with the following text (see document TC/49/41 “Report on the Conclusions”, paragraph 46):

> “A representative color photograph of the variety displaying its main distinguishing feature(s), should accompany the Technical Questionnaire. The photograph will provide a visual illustration of the candidate variety which supplements the information provided in the Technical Questionnaire.
>
> “The key points to consider when taking a photograph of the candidate variety are:
>
> - Indication of the date and geographic location
> - Correct labeling (breeder’s reference)
> - Good quality printed photograph (minimum 10 cm x 15 cm) and/or sufficient resolution electronic format version (minimum 960 x 1280 pixels)”
>
> “Further guidance on providing photographs with the Technical Questionnaire is available at: http://www.upov.int/edocs/tgpdocs/en/tgp_7.pdf [to be provided]”
>
> “The link provided may be deleted by members of the Union when developing authorities’ own test guidelines.”
>
> See also GN 35, document TC-EDC/Jan14/2, Annex I, page 15

Consequential changes:

To insert the following text after ASW 16 in Annex 1, Section 7.3:

> “{ GN 35 (Chapter 10: TQ 7.3) – guidance for applicants on providing suitable photographs of the candidate variety as accompaniment to the Technical Questionnaire }”

ANNEX 3: GUIDANCE NOTES (GN) FOR THE TG TEMPLATE

GN 7: Quantity of Plant Material Required

To replace current GN 7 with the following text (see document TC/49/41 “Report on the Conclusions”, paragraph 35):

“The drafter of the Test Guidelines should consider the following factors when determining the quantity of material required:

(i) Number of plants/ parts of plants to be examined
(ii) Number of growing cycles
(iii) Variability within the crop
(iv) Additional tests (e.g. resistance tests, bolting trials)
(v) Features of propagation (e.g. cross-pollination, self-pollination, vegetative propagation)
(vi) Crop type (e.g. root crop, leaf crop, fruit crop, cut flower, cereal, etc.)
(vii) Storage in variety collection
(viii) Exchange between testing authorities
(ix) Seed quality (germination) requirements
(x) Cultivation system (outdoor/glasshouse)
(xi) Sowing system
(xii) Predominant method of observation (e.g. MS, VG)

“In general, in the case of *plants* required only for a single growing trial (e.g. no plants required for special tests or variety collections), the number of plants requested in Chapter 2.3 often corresponds to the number of plants specified in Chapters 3.4 “Test Design” and 4.2 “Uniformity”. In that respect, it is recalled the quantity of plant material specified in Chapter 2.3 of the Test Guidelines is the minimum quantity that an authority might request of the applicant. Therefore, each authority may decide to request a larger quantity of plant material, for example to allow for potential losses during establishment (see GN 7 (a)). In relation to the number of plants specified in Chapter 2.3, the number of plants/parts of plant to be examined (Chapter 4.1.4), should at least allow for the possibility of off-type plants within the tolerated number to be excluded from observations.”

GN 10.2: (New) Guidance on Number of Plants to be Examined (for Distinctness)

To add new GN 10.2 as follows (see document TC/49/41 “Report on the Conclusions”, paragraph 40):

“GN 10.2 (TG Template: Chapter 4.1.4) - Number of Plants / Parts of Plants to be Examined (for distinctness)

“1. The observation of the '*typical'* expression of characteristics of a variety in a given environment is essential for the assessment of distinctness. The precision of the observed (mean) expression of the varieties to be compared is a critical element for the consideration of whether a difference is a clear difference.

“2. In the case of qualitative characteristics, a low number is sufficient to identify the expression of a variety. In general, the number of plants for the assessment of distinctness is not a limiting factor for the number of plants in the trial. Thus, the number of plants for the assessment of qualitative characteristics is not essential for harmonization.

“3. In case of quantitative characteristics (and pseudo-qualitative characteristics), the variation within the variety has to be taken into account for defining a clear difference (by expert judgment or exact statistics). Due to the relation between variation within the varieties and the required difference to be considered as a clear difference for the establishment of distinctness the precision of records is important. The precision of records (mean values) is influenced by the sample size. Therefore, the appropriate sample size should be indicated in the Test Guidelines for the purpose of harmonization.

"4. The following general principals should be taken into account:

"*Considerations for the number of plants to be observed for distinctness in case of QN (*in some cases *PQ)*

(a) Observation on the plot as a whole (VG/MG)
– the indicated number should be considered as minimum number

(b) Observation on subsample from plot (VG/MG)
– the indicated number should be considered as minimum number

(c) Observations on individual plants (VS/MS)
– the number of plants is important for precision of record
– the specific number should be indicated

"*Considerations for the number of plants for candidate varieties and varieties to be compared with the candidate varieties*

"5. The required precision of records depends on the size of the difference between the candidate variety and the varieties of common knowledge. If two varieties are very similar it is important to ensure the same precision of the records for both varieties. The number of plants indicated in the Test Guidelines applies to both the candidate variety and the similar variety of common knowledge. In other cases, it may be possible to include in the trial a lower number of plants for the variety of common knowledge, provided that uniformity does not have to be assessed for that variety, i.e. varieties in the variety collection."

Consequential changes:

To renumber current GN 10 to become "GN 10.1"

"GN 10.1 (TG Template: Chapter 3.4) – Test design"

To insert in Annex I: Section 4.1.4, after "ASW 7(b)"

"{ GN 10.2 (Chapter 4.1.4) – Number of Plants / Parts of Plants to be Examined }"

GN 13: Selection of Asterisked Characteristics

To replace last sentence of GN 13: Section 1.2 with the following text (see document TC/47/26 "Report on the Conclusions", paragraph 59):

"The number of asterisked characteristics should, therefore, be determined by the characteristics which are required to achieve useful internationally harmonized variety descriptions."

GN 25: Guidance for Method of Observation

To replace current GN 25 with the following text (see document TC/49/41 "Report on the Conclusions", paragraph 42):

"This box provides the key for guidance on conducting the examination. For example, recommendations on the method of observation (e.g.: visual assessment or measurement; observation of single plants or a group of plants) or type of plot (e.g.: spaced plants; row plot; drilled plot; special test) may be provided. ASW 4(b) provides possible standard wording.

"Method of observation (visual or measurement)

"1. Document TGP/9 "Examining Distinctness" explains the following with regard to method of observation:

"4.2 Method of observation (visual or measurement)

"The expression of characteristics can be observed visually (V) or by measurement (M).

"4.2.1 Visual observation (V)

"4.2.1.1 '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).

[…]

"4.2.2 Measurement (M)

"Measurement (M) is an objective observation against a calibrated, linear scale e.g. using a ruler, weighing scales, colorimeter, dates, counts, etc.'

"2. The following examples are intended to illustrate the ways of considering the method of observation for characteristics such as time of flowering and counts.

"(a) Time of Flowering

	Time of flowering	
QN	early	3
	medium	5
	late	7

"*Scenario A (Explanation: the time of flowering is assessed by date)*

"3. The DUS trial is visited on various dates to assess whether each variety has reached the time of flowering. The assessment of whether 50% of plants have emitted the stigma in the main panicle is made by counting the number of plants that have emitted their stigmas to determine the percentage, or by an overall assessment of the percentage.

"4. In this case, the method of observation would be measurement (M), because the determination of the state of expression will be according to the date (= measurement on a time scale) at which a variety was found to have reached the time of flowering. A date is

recorded for each variety, which is transformed into notes after assessment of all varieties.

"*Scenario B (Explanation: the time of flowering is assessed by comparison with other varieties)*

"5. The DUS trial is visited on one or more occasions to assess the time of flowering by reference to example varieties.

"6. In this scenario, the time of flowering is a visual (V) observation because an overall visual observation is made as to the time of flowering for a particular variety by reference to the state of flowering of example varieties, without reference to a date of visit. A note is recorded for each variety in relation to the variation between varieties (e.g. early, medium, late).

"(b) Number

"7. If a characteristic is observed by counting (for example 'Number of lobes' observed by counting), the assessment is a measurement (M). If a characteristic is observed by estimation (for example 'Number of lobes' observed by estimation), the assessment is a visual observation (V)."

GN 28: Example Varieties

To replace current GN 28 with the following text (see document TC/49/41 "Report on the Conclusions", paragraph 44):

"GN 28 (TG Template: Chapter 6.4) – Example varieties

"1. Deciding where example varieties are needed for a characteristic

"1.1 The General Introduction (Chapter 4.3) states that "example varieties are provided in the Test Guidelines to clarify the states of expression of a characteristic." This clarification of the states of expression is required with respect to two aspects:

(a) to illustrate the characteristic and/or

(b) to provide the basis for ascribing the appropriate state of expression to each variety and, thereby, to develop internationally harmonized variety descriptions. (Further information on these two aspects is provided in Section 4 "Purpose of Example Varieties")

"1.2 UPOV has, in particular, identified "Asterisked Characteristics" as those which are important for the international harmonization of variety descriptions.

"1.3 The decision on whether example varieties are required for a characteristic can be summarized as follows:

(i) If a characteristic is not important for the international harmonization of variety descriptions (non-asterisked characteristic) and example varieties are not necessary for illustration of the characteristic (see Section 3.1), there is no requirement for example varieties to be provided.

(ii) If a characteristic which is important for the international harmonization of variety descriptions (asterisked characteristic) is not influenced by the year or environment (e.g. qualitative characteristics) and example varieties are not necessary for illustration of the characteristic (see Section 1.1), it may not be necessary to provide example varieties.

(iii) If a characteristic is important for the international harmonization of variety descriptions (asterisked characteristics) and is influenced by the environment (most quantitative and pseudo-qualitative characteristics) or example varieties are necessary for illustration of the characteristic (see Section 3.1) it is necessary to provide example varieties.

(iv) If example varieties are considered necessary according to (i) to (iii) above, but it is not appropriate to seek to develop a universal set of example varieties that is applicable for all UPOV members, the development of regional sets of example varieties should be considered.

"1.4 The process for deciding if example varieties need to be provided for a characteristic is illustrated in the following Flow Diagram 1. Flow Diagram 2 indicates where example varieties should be provided in the case of regional sets of example varieties (see Section 4).

"2. Criteria for Example Varieties

"2.1 Availability

"Authorities responsible for DUS testing and breeders need to be able to obtain plant material of example varieties and therefore, in general, example varieties should be widely and readily available for the coverage of the Test Guidelines or, in case of regional sets of example varieties, for the region concerned. For this reason, at the point of starting to draft Test Guidelines, drafters are encouraged to seek lists of varieties from interested parties in order to identify example varieties with the widest availability.

"2.2 Minimizing the number

"For practical reasons it is recommended to choose the overall set of example varieties for the Test Guidelines in a way that all the desired characteristics and states of expression are covered by the minimum total number of example varieties. This means that, if possible, each example variety should be used for as many characteristics as possible and example varieties should not be used only for one or very few characteristics.

"2.3 Agreement of interested experts

"2.3.1 The set of example varieties proposed by the Leading Expert in the preparation of the Test Guidelines should be prepared in cooperation with all the interested experts. If one or more expert(s) consider(s) that certain example varieties are not suitable for their conditions, a new example variety should, if possible, be found (see also Section 3 "Multiple sets of example varieties").

"2.3.2 It is important that the set of example varieties for a particular characteristic is developed by one expert in order to ensure that the set of example varieties for that characteristic represents the same scale. Example varieties proposed by other experts, for the same characteristic, should be known to represent the same scale before they are accepted in Test Guidelines. In cases where it is necessary to develop a separate scale for different types of variety, or different regions, multiple sets of example varieties may need to be developed (see Section 3 "Multiple sets of example varieties").

"2.4 Illustration of the range of expression within the variety collection

"The set of example varieties for a given characteristic should provide information on the range of expression of the characteristic in the collection of varieties covered by the Test Guidelines. Thus, in general, it is necessary to provide example varieties for more than one state of expression and in the case of:

"Quantitative characteristics:

(i) "1-9" scale: to provide example varieties for at least three states of expression (e.g. (3), (5) and (7)), although, in exceptional cases, example varieties for only two states of expression may be accepted;

(ii) "1-5" / "1-4" / "1-3" scales: to provide example varieties for at least two states of expression.

"Pseudo-qualitative characteristics: to provide a set of example varieties to cover the different types of variation within the range of expression of the characteristics.

"2.5 Regional sets of example varieties

"2.5.1 Basis for regional sets of example varieties

"UPOV Test Guidelines need to cover all the different countries, regions and environments where the DUS examinations are conducted and, as far as possible, they provide universal sets of example varieties in order to maximize harmonization of variety descriptions. However, the regional adaptation of varieties in some genera and species may mean that it is inappropriate to seek to harmonize variety descriptions on a global basis and, therefore, inappropriate to seek to develop a universal set of example varieties. Nevertheless, in such cases, regional harmonization is important and is facilitated by providing regional sets of example varieties as summarized in Flow Diagram 2 in section 3.4. The rationale for identifying regional types will be explained in the Test Guidelines and, where appropriate, correlation between the different regional sets of example varieties may be established.

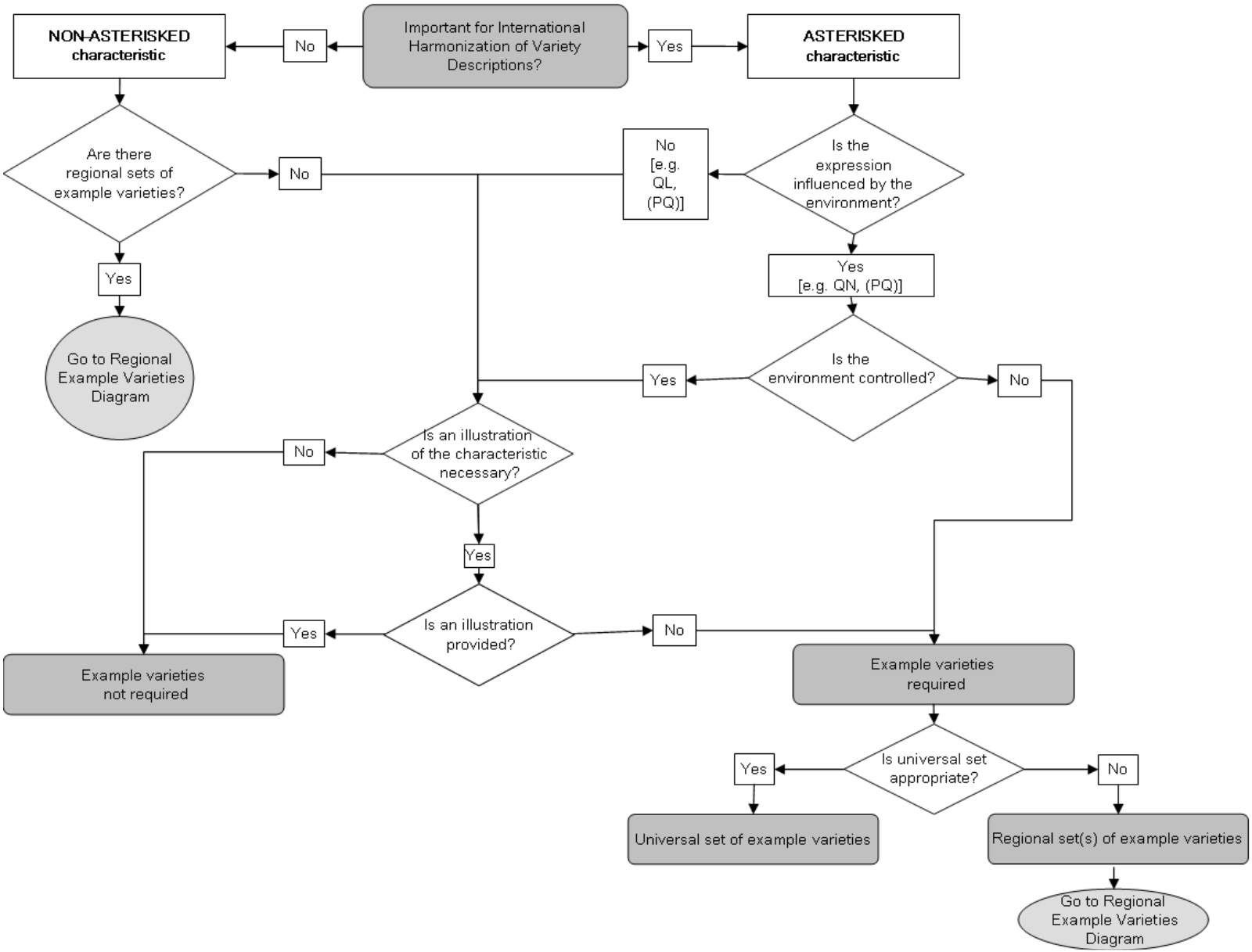
“2.5.2 Procedure for developing regional sets

“2.5.2.1 In cases where the relevant TWP agrees to the development of regional sets of example varieties, the TWP concerned will determine the regions and the contributors of regional lists of varieties.

“2.5.2.2 In cases where it is known by the relevant TWP that regional sets of example varieties are to be developed, this will be stated in the Test Guidelines.

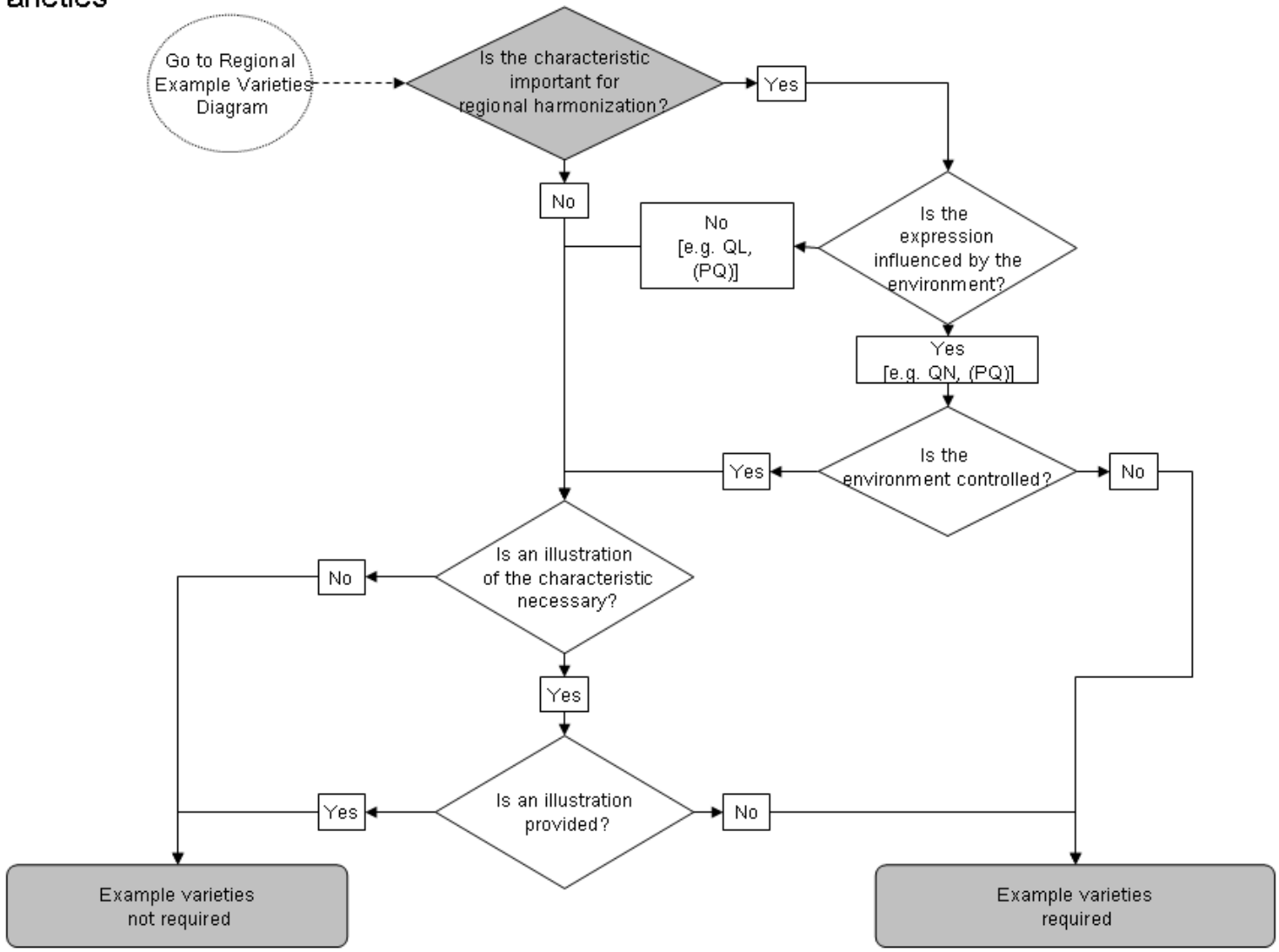
Flow Diagram 1

Deciding if Example Varieties are needed for a characteristic



Flow Diagram 2

Deciding if Example Varieties are needed for a characteristic: Regional Sets of Example Varieties



"3. Multiple sets of example varieties

"3.1 Presentation of Regional Sets of Example Varieties

"3.1.1 The existence of multiple sets of example varieties means that, for some or all characteristics, no example varieties are presented in the Table of Characteristics and the multiple sets of example varieties are presented in an annex available on the UPOV Website which is presented as follows:

	Region A					
Example varieties	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	*etc.*
Variety A	3	1	3		3	
Variety B	5	2	7	1	1	
Variety C	7	3	5	9	2	
Variety D		4			4	
etc.						

	Region B					
Example varieties	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	*etc.*
Variety I	3	4	5		1	
Variety II	5	2	3	1	2	
Variety III	7	1	7	9	3	
Variety IV		3			4	
etc.						

"3.1.2 Even where the "example variety" column is empty (i.e. there are no universal example varieties for any characteristic), the column is retained in the Table of Characteristics to allow users to complete this with the appropriate example varieties.

"3.2 Different types of variety

3.2.1 If it is not possible, with a single set of example varieties, to describe all the types of varieties (e.g. winter-types and spring-types) covered by the same Test Guidelines, they may be subdivided to create different sets of example varieties.

"3.2.2 Where different sets of example varieties are provided for different types of varieties covered by the same Test Guidelines, they are placed in the Table of Characteristics in the same column as normal. The two sets of example varieties (e.g. winter and spring) are separated by a semicolon, with a key provided for each set and an explanation included in the legend of chapter 6 of the Test Guidelines.

"Example: For certain characteristics, different example varieties are indicated for winter type and spring type varieties. These types are separated by a semicolon, with the winter types placed before the semicolon and prefixed by "(w)" and the spring types placed after the semicolon and prefixed by "(s)".

	Stage/ Stade/ Stadium/ Estado	English	français	deutsch	español	Example Varieties/ Exemples/ Beispielssorten/ Variedades ejemplo	Note/ Nota
7. (*) (+)	**75-92 MG/MS**	**Plant: length**	**Plante: port**	**Pflanze: Wuchs-form**	**Planta: porte**		
		short	courte	kurz	corta	(w) Variety A, Variety C; (s) Alpha	3
		medium	moyenne	mittel	media	(w) Variety B; (s) Beta	5
		long	longue	lang	larga	(s) Gamma	7

"4. Purpose of example varieties

"The General Introduction (Chapter 4.3) states that "example varieties are provided in the Test Guidelines to clarify the states of expression of a characteristic." This clarification of the states of expression is required with respect to two aspects:

(a) to illustrate the characteristic and/or

(b) to provide the basis for ascribing the appropriate state of expression to each variety and, thereby, to develop internationally harmonized variety descriptions.

"4.1 Illustration of a characteristic

"Although example varieties have the benefit of enabling examiners to see a characteristic in "real life", in many cases, the illustration of a characteristic by photographs or drawings (to be provided in chapter 8 of the Test Guidelines) may provide a clearer illustration of the characteristic. Furthermore, the difficulty in selecting suitable example varieties, which satisfy all the requirements in Section 2 below, means that photographs or drawings are an important alternative or addition to example varieties as a means of illustrating characteristics.

"4.2 International Harmonization of Variety Descriptions

"4.2.1 The main reason why example varieties are used in place of, for example, actual measurements is that measurements can be influenced by the environment.

(a) Example varieties in the Test Guidelines

"4.2.3 Example varieties are important to adjust the description of the characteristics for the year and location effects, as far as possible. Thus, using the relative scale provided by the example varieties, it can be seen that the example variety Beta measured 10 cm in Country A and 15 cm in Country B, but in both locations demonstrates the state of expression "medium". On this basis, candidate variety X would be considered to have a medium length leaf in both Countries A and B.

	Example Varieties	Note
Leaf: length of blade		
short	Alpha	3
medium	Beta	5
long	Gamma	7

(b) Fixed measurements in the Test Guidelines

"4.2.4 If absolute measurements were to be indicated in the Test Guidelines and the Test Guidelines were drafted in Country A on the basis of the data from Figure 1, the Table of Characteristics would show the following:

	Length	Note
Leaf: length of blade		
short	5 cm	3
medium	10 cm	5
long	15 cm	7

"4.2.5 Because there is no "relative scale" provided by the example varieties, the same data as for Figure 1 would lead to the following descriptions:

	Country A	Country B
Variety X	10 cm **(medium: note 5)**	15 cm **(long: note 7)**

"4.2.6 Thus, if absolute measurements were used in the Test Guidelines, variety X, when grown in Country A, would be described as "medium (note 5)", but if grown in Country B, would be described as "long (note 7)". This demonstrates that it could be very misleading to compare descriptions from different locations on the basis of absolute measurements, without the adjustment for year or location effects provided by example varieties.

"4.2.7 Nevertheless, because of the possibility of particular interactions between the variety genotype and location (e.g. influence of photoperiod), it should not be assumed that descriptions developed in different countries or locations using the same set of example varieties will be the same (see also section 2.2). Guidance on the scope for comparison of varieties on the basis of descriptions produced in different locations is provided in document TGP/9, Examining Distinctness."

GN 35 (New): Providing Photographs with the Technical Questionnaire

To add new GN 35 as follows (see document TC/49/41 "Report on the Conclusions", paragraph 46):

"GN 35 (TG Template: Chapter 10: TQ 7.3) – guidance for applicants on providing suitable photographs of the candidate variety as accompaniment to the Technical Questionnaire

"Introduction

"The taking of photographs of candidate varieties is influenced by factors, such as light conditions, quality and setting of the camera, and the background. The perception of the photograph can also be affected by the quality, settings and resolution of the screen and printout or developed photographs. It is not possible to standardize all conditions when photos are taken in different premises but this document aims to provide guidance in order to provide meaningful and coherent information on the candidate variety, while on the one side decreasing the influence of the origin of the photograph (location, equipment, etc), and on the other side making the relevant authorities aware of possible influences to be taken into account when making use of the photographs provided. By decreasing the influence of these external factors on the taking of photographs, it will in particular help to ensure that "color", the trait most liable to be affected by such factors, will be reliably represented in photographs provided by applicants.

"Criteria for taking photographs

"Format

"Photographs must be in color and submitted either in print form of at least 10cm x 15 cm, and/or as an electronic photo in a frequently used format such as jpeg (minimum 960x1280 pixels). The photograph must be well focused and aim to have the plants or plant parts occupy as much of the frame of the photograph as possible. It should be noted that different makes/models of computer screens can influence the expression of the color and the advantage of a printout is that the applicant can make a comment, e.g. actual color darker, and the examination authority would see exactly the same printout. Conversely, the advantages of having an image in an electronic format are that this could display the camera type and settings, date and GPS location of the taken photo, the possibility to exchange the image instantaneously via electronic means, and the possibility to store the image indefinitely electronically without a reduction in quality.

"Best time for taking photographs

"Photographs must illustrate plants of the candidate variety at the stage when the distinguishing features of the variety are most apparent. Often this is when the plants are fully developed and at the stage when they are of commercial value (e.g. flowering for many ornamentals, fruiting for many fruit species), which usually corresponds to the most numerous set of characteristics in the corresponding UPOV guideline for the species in question.

"Photographic environment

"Photographs should be taken under adequate light conditions and with an appropriate background. It is preferable to have photographs taken indoors, since one can ensure homogenous photographic conditions irrespective of the type of photographs and number of candidate varieties supplied by the same applicant. The background of the photograph should be neutral (e.g. off-white in case of dark colors or grey in case of light colors) and should not have a shiny surface. If the photograph is taken indoors, then this should preferably be done in the same room and under artificial light conditions which will ensure identical and ample luminosity on repeated occasions over time. If a photograph has to be taken outdoors, then this should not be in direct sunlight but in a shaded area with as much indirect natural light as possible or on a cloudy day.

"Specification of growing conditions

"The applicant should provide information on the date and location of the photograph taken. The plants of the candidate variety appearing in the photographs should have been grown under standard growing conditions for the crop in question, or under any specific conditions as may

have been indicated for the candidate variety in the Technical Questionnaire (e.g. indoor, outdoor, season of the year). If this is not the case, then any possible alteration in the expression of the characteristic(s) appearing in the photographs must be specified (e.g. seasonal conditions may influence the color and pattern of fruit and flowers, such as over coloring in apple according to outdoor light intensity and night temperatures, delphinium grown either outdoors or indoors).

"Plant organs to be displayed

"The photographs should show the plant parts which are a distinguishing feature of the candidate variety, as well as those of the whole plant and the most important commercial organs (flower, fruit, etc.). If the distinguishing features of the candidate variety are very specific (e.g. seed size, shape of leaf/flower/fruit, length of awns, color pattern of flower/fruit, etc.) it is recommended to remove these plant parts from the plant and take a well-focused close-up photograph of them. For some crops (e.g. peach, tomato), a photograph of a mass view of several harvested fruit in an industry-standard tray can provide of valuable illustration of the candidate variety.

"Similar varieties

"Although not a requirement, the applicant may wish to illustrate differences between the candidate variety and the variety thought to be the most similar as nominated by him/her under point 6 of the Technical Questionnaire, by providing photographs of the candidate variety alongside the aforesaid similar variety. In such photographs, the distinguishing plant parts of the candidate variety should be photographed alongside the same plant parts of the nominated similar variety(ies). Where there is more than one similar variety named by the applicant, a separate photograph of the relevant plant parts of the candidate variety and each of those of the similar varieties could be provided.

"Labeling

"A photograph must be clearly labeled with the breeder's reference and/or (proposed) variety denomination of the candidate variety; trade names may be used only in addition to the breeder's reference and/or (proposed) variety denomination.

"Metric scales

"A metric scale in centimeters – also millimeters where a close-up photograph has been taken – should ideally appear along the horizontal and/or vertical margins of the photograph.

"Color characteristics

"For ornamental species, reference to the relevant RHS Colour Chart placed alongside the pertinent plant organ (e.g. flower) provides greater precision. For other crop sectors, industry-recognized color charts can also be displayed alongside the pertinent plant organ (e.g. apple fruit). Likewise, the color itself of the plant organ may not be the most representative feature of the candidate variety but rather the color pattern (e.g. pattern of over color in apple fruit, stripes/spots/netting in *Phalaenopsis*), and this can be well illustrated in a clear and well focused photograph."

[Annex II follows]

ANNEX II

REVISION OF DOCUMENT TGP/8: MATTERS APPROVED BY THE TC

TABLE OF CONTENTS

PART I: DUS TRIAL DESIGN AND DATA ANALYSIS

Section 2 (New): Data to be Recorded

To add new Section 2 as follows (see document TC/49/41 "Report on the Conclusions", paragraph 49):

"2.1 Introduction

"Document TGP/9 Examining Distinctness, sections 4.4 and 4.5, provide the following guidance on the type of observation for distinctness in respect of the type of characteristic and the method of propagation of the variety:

"4.4 Recommendations in the UPOV Test Guidelines

"The indications used in UPOV Test Guidelines for the method of observation and the type of record for the examination of distinctness, are as follows:

"Method of observation

"M: to be measured (an objective observation against a calibrated, linear scale e.g. using a ruler, weighing scales, colorimeter, dates, counts, etc.);

"V: to be observed visually (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). "Visual" observation refers to the sensory observations of the expert and, therefore, also includes smell, taste and touch.

"Type of record(s)

"G: single record for a variety, or a group of plants or parts of plants;

"S: records for a number of single, individual plants or parts of plants

"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.

"4.5 Summary

"The following table summarizes the common method of observation and type of record for the assessment of distinctness, although there may be exceptions:

	Type of expression of characteristic		
Method of propagation of the variety	QL	PQ	QN
Vegetatively	VG	VG	VG/MG/MS
Self-pollinated	VG	VG	VG/MG/MS
Cross-pollinated	VG/(VS*)	VG/(VS*)	VS/VG/MS/MG
Hybrids	VG/(VS*)	VG/(VS*)	*

* Records of individual plants only necessary if segregation is to be recorded.
** To be considered according to the type of hybrid."

"2.2 Types of expression of characteristics

"2.2.1 Characteristics can be classified according to their types of expression. The following types of expression of characteristics are defined in the General Introduction to the "Examination of Distinctness, Uniformity and Stability and the Development of Harmonized Descriptions of New Varieties of Plants, (document TG/1/3, the "General Introduction", Chapter 4.4):

"2.2.2 "Qualitative characteristics" (QL) are those that are expressed in discontinuous states (e.g. sex of plant: dioecious female (1), dioecious male (2), monoecious unisexual (3), monoecious hermaphrodite (4)). These states are self-explanatory and independently meaningful. All states are necessary to describe the full range of the characteristic, and every form of expression can be described by a single state. The order of states is not important. As a rule, the characteristics are not influenced by environment.

"2.2.3 "Quantitative characteristics" (QN) are those where the expression covers the full range of variation from one extreme to the other. The expression can be recorded on a one-dimensional, continuous or discrete, linear scale. The range of expressions is divided into a number of states for the purpose of description (e.g. length of stem: very short (1), short (3), medium (5), long (7), very long (9)). The division seeks to provide, as far as practical, an even distribution across the scale. The Test Guidelines do not specify the difference needed for distinctness. The states of expression should, however, be meaningful for DUS assessment.

"2.2.4 In the case of "pseudo-qualitative characteristics" (PQ) the range of expression is at least partly continuous, but varies in more than one dimension (e.g. shape: ovate (1), elliptic (2), circular (3), obovate (4)) and cannot be adequately described by just defining two ends of a linear range. In a similar way to qualitative (discontinuous) characteristics – hence the term "pseudo-qualitative" – each individual state of expression needs to be identified to adequately describe the range of the characteristic.

"2.3 Types of scales of data

"2.3.1 The possibility to use specific procedures for the assessment of distinctness, uniformity and stability depends on the scale level of the data which are recorded for a characteristic. The scale level of data depends on the type of expression of the characteristic and on the way of recording this expression. The type of scale may be nominal, ordinal, interval or ratio.

"2.3.2 *Data from qualitative characteristics*

"2.3.2.1 Data results from qualitative characteristics are nominal scaled data without any logical order of the discrete categories. They result from visually assessed (notes) qualitative characteristics.

"Examples:

Type of scale	Example	Example number
nominal	Sex of plant	1
nominal with two states	Leaf blade: variegation	2

For description of the states of expressions, see Table 6.

"2.3.2.2 A nominal scale consists of numbers which correspond to the states of expression of the characteristic, which are referred to in the Test Guidelines as notes. Although numbers are used for designation there is no logical order for the expressions and so it is possible to arrange them in any order.

"2.3.2.3 Characteristics with only two categories (dichotomous characteristic) are a special form of a nominal scaled characteristic.

"2.3.2.4 The nominal scale is the lowest classification of the scales (Table 1). Few statistical procedures are applicable for evaluations (section 2.3.8 *[cross ref.]*).

"2.3.3 *Data from quantitative characteristics*

"2.3.3.1 Data results from quantitative characteristics are metric (ratio or interval) or ordinal scaled data.

"2.3.3.2 Metric scaled data are all data which are recorded by measuring or counting. Weighing is a special form of measuring. Metric scaled data can have a continuous or a discrete distribution. Continuous metric data result from measurements. They can take every value out of the defined range. Discrete metric data result from counting.

Examples

Type of scale	Example	Example number
Continuous metric	Plant length in cm	3
Discrete metric	Number of stamens	4

For description of the states of expression, see Table 6.

"2.3.3.3 The continuous metric scaled data for the characteristic "Plant length" are measured on a continuous scale with defined units of assessment. A change of unit of measurement e.g. from cm into mm is only a question of precision and not a change of type of scale.

"2.3.3.4 The discrete metric scaled data of the characteristic "Number of stamens" are assessed by counting (1, 2, 3, 4, and so on). The distances between the neighbouring units of assessment are constant and for this example equal to 1. There are no real values between two neighbouring units but it is possible to compute an average which falls between those units.

"2.3.3.5 Metric scales can be subdivided into ratio scales and interval scales.

"2.3.3.6 *Ratio scale*

"2.3.3.6.1 A ratio scale is a metric scale with a defined absolute zero point. There is always a constant non-zero distance between two adjacent expressions. Ratio scaled data may be continuous or discrete.

"The absolute zero point:

"2.3.3.6.2 The definition of an absolute zero point makes it possible to define meaningful ratios. This is a requirement for the construction of indexes, which are the combination of at least two characteristics (e.g. the ratio of length to width). In the General Introduction, this is referred to as a combined characteristic (see document TG/1/3, section 4.6.3).

"2.3.3.6.3 It is also possible to calculate ratios between expressions of different varieties. For example, in the characteristic 'Plant length' assessed in cm, there is a lower limit for the expression which is '0 cm' (zero). It is possible to calculate the ratio of length of plant of variety 'A' to length of plant of variety 'B' by division:

"Length of plant of variety 'A' = 80 cm
"Length of plant of variety 'B' = 40 cm
"Ratio = Length of plant of variety 'A' / Length of plant of variety 'B'
= 80 cm / 40 cm
= 2.

"2.3.3.6.4 So it is possible in this example to state that plant 'A' is double the length of plant 'B'. The existence of an absolute zero point ensures an unambiguous ratio.

"2.3.3.6.5 The ratio scale is the highest classification of the scales (Table 1). That means that ratio scaled data include the highest information about the characteristic and it is possible to use many statistical procedures (section 2.3.8 *[cross ref.]*).

"2.3.3.6.6 The examples 3 and 4 (Table 6) are examples for characteristics with ratio scaled data.

"2.3.3.7 *Interval scale*

"2.3.3.7.1 An Interval scale is a metric scale without a defined absolute zero point. There is always a constant non-zero distance between two adjacent units. Interval scaled data may be distributed continuously or discretely.

"2.3.3.7.2 An example for a discrete interval scaled characteristic is 'Time of beginning of flowering' measured as date which is given as example 5 in Table 6. This characteristic is defined as the number of days from April 1. The definition is useful but arbitrary and April 1 is not a natural limit. It would also be possible to define the characteristic as the number of days from January 1.

"2.3.3.7.3 It is not possible to calculate a meaningful ratio between two varieties which is illustrated by the following example:

"Variety 'A' begins to flower on May 30 and variety 'B' on April 30

"Case I) Number of days from April 1 of variety 'A' = 60
Number of days from April 1 of variety 'B' = 30

$$\text{Ratio}_I = \frac{\text{Number of days from April 1 of variety 'A'}}{\text{Number of days from April 1 of variety 'B'}} = \frac{60}{30} = 2$$

"Case II) Number of days from January 1 of variety 'A' = 150
Number of days from January 1 of variety 'B' = 120

$$= \frac{150\text{days}}{120\text{days}} = 1.25 \quad \text{Ratio}_{II} = \frac{\text{Number of days from January 1 of variety 'A'}}{\text{Number of days from January 1 of variety 'B'}} = \frac{150}{120} = 1.25$$

$\text{Ratio}_I = 2 > 1.25 = \text{Ratio}_{II}$

"2.3.3.7.4 It is incorrect to state that the time of flowering of variety 'A' is twice that of variety 'B'. The ratio depends on the choice of the zero point of the scale. This kind of scale is defined as an "Interval scale": a metric scale without a defined absolute zero point.

"2.3.3.7.5 The interval scale is lower classified than the ratio scale (Table 1). At the interval scale, no useful indexes can be formed such as ratios. The interval scale is theoretically the minimum scale to calculate arithmetic mean values.

"2.3.3.8 *Ordinal scale*

"2.3.3.8.1 Discrete categories of ordinally scaled data can be arranged in an ascending or descending order. They result from visually assessed (notes) quantitative characteristics.

"Example:

Type of scale	Example	Example number
ordinal	Intensity of anthocyanin	6

For description of the states of expressions, see Table 6

"2.3.3.8.2 An ordinal scale consists of numbers which correspond to the states of expression of the characteristic (notes). The expressions vary from one extreme to the other and thus they have a clear logical order. It is not important which numbers are used to denote the categories. In some cases ordinal data may reach the level of discrete interval scaled data or of discrete ratio scaled data (section 2.3.8 *[cross ref.]*).

"2.3.3.8.3 The distances between the discrete categories of an ordinal scale are not exactly known and not necessarily equal. Therefore, an ordinal scale does not fulfil the condition to calculate arithmetic mean values, which is the equality of intervals throughout the scale.

"2.3.3.8.4 The ordinal scale is lower classified than the interval scale (Table 1). Fewer statistical procedures can be used for ordinal scale than for each of the higher classified scale data (section 2.3.8 *[cross ref.]*).

"2.3.4 *Data from pseudo-qualitative characteristics*

"2.3.4.1 Data results from pseudo-qualitative characteristics are nominal scaled data without any logical order of all discrete categories. They result from visually assessed (notes) qualitative characteristics.

"Examples:

Type of scale	Example	Example number
nominal	Shape	7
nominal	Flower color	8

For description of the states of expressions, see Table 6.

"2.3.4.2 A nominal scale consists of numbers which correspond to the states of expression of the characteristic, which are referred to in the Test Guidelines as notes. Although numbers are used for designation there is no inevitable order for all of the expressions. It is possible to arrange only some of them in an order.

"2.3.4.3
The nominal scale is the lowest classification of the scales (Table 1). Few statistical procedures are applicable for evaluations (section 2.3.8 *[cross ref.]*).

"2.3.5 The different types of scales are summarized in the following table:

Table 1: Types of expressions and type of scales

Type of expression	Type of scale	Description	Distribution	Data recording	Scale Level
QN	ratio	constant distances with absolute zero point	Continuous	Absolute measurements	High
			Discrete	Counting	
	interval	constant distances without absolute zero point	Continuous	Relative measurements	↑
			Discrete	Date	
	ordinal	Ordered expressions with varying distances	Discrete	Visually assessed notes	↑
PQ or QL	nominal	No order, no distances	Discrete	Visually assessed notes	Low

"2.3.6 *Scale levels for variety description*

The description of varieties is based on the states of expression (notes) which are given in the Test Guidelines for the specific crop. In the case of visual assessment, the notes from the Test Guidelines are usually used for recording the characteristic as well as for the assessment of DUS. The notes are distributed on a nominal or ordinal scale (see Part I: section 4.5.4.2 *[cross ref.]*). For measured or counted characteristics, DUS assessment is based on the recorded values and the recorded values are transformed into states of expression only for the purpose of variety description.

"2.3.7 *Relation between types of expression of characteristics and scale levels of data*

"2.3.7.1
Records taken for the assessment of qualitative characteristics are distributed on a nominal scale, for example "Sex of plant", "Leaf blade: variegation" (Table 6, examples 1 and 2).

"2.3.7.2 For quantitative characteristics the scale level of data depends on the method of assessment. They can be recorded on a metric (when measured or counted) or ordinal (when visually observed) scale. For example, "Length of plant" can be recorded by measurements resulting in ratio scaled continuous metric data. However, visual assessment on a 1 to 9 scale may also be

appropriate. In this case, the recorded data are ordinal scaled because the size of intervals between the midpoints of categories is not exactly the same.

"Remark: In some cases visually assessed data on metric characteristics may be handled as measurements. The possibility to apply statistical methods for metric data depends on the precision of the assessment and the robustness of the statistical procedures. In the case of very precise visually assessed quantitative characteristics the usually ordinal data may reach the level of discrete interval scaled data or of discrete ratio scaled data.

"2.3.7.3 A pseudo-qualitative type of characteristic is one in which the expression varies in more than one dimension. The different dimensions are combined in one scale. At least one dimension is quantitatively expressed. The other dimensions may be qualitatively expressed or quantitatively expressed. The scale as a whole has to be considered as a nominal scale (e.g. "Shape", "Flower color"; Table 6, examples 7 and 8).

"2.3.7.4 In the case of using the off-type procedure for the assessment of uniformity the recorded data are nominally scaled. The records fall into two qualitative classes: plants belonging to the variety (true-types) and plants not belonging to the variety (off-types). The type of scale is the same for qualitative, quantitative and pseudo-qualitative characteristics.

2.3.7.5 The relation between the type of characteristics and the type of scale of data recorded for the assessment of distinctness and uniformity is described in Table 2. A qualitative characteristic is recorded on a nominal scale for distinctness (state of expression) and for uniformity (true-types vs. off-types). Pseudo-qualitative characteristics are recorded on a nominal scale for distinctness (state of expression) and on a nominal scale for uniformity (true-types vs. off-types). Quantitative characteristics are recorded on an ordinal, interval or ratio scale for the assessment of distinctness depending on the characteristic and the method of assessment. If the records are taken from single plants the same data may be used for the assessment of distinctness and uniformity. If distinctness is assessed on the basis of a single record of a group of plants, uniformity has to be judged with the off-type procedure (nominal scale).

Table 2: Relation between type of characteristic and type of scale of assessed data

Procedure	Type of scale	Distribution	Type of characteristic		
			Qualitative	Pseudo-qualitative	Quantitative
Distinctness	ratio	Continuous	No	No	**Yes**
		Discrete	No	No	**Yes**
	interval	Continuous	No	No	**Yes**
		Discrete	No	No	**Yes**
	ordinal	Discrete	No	No	**Yes**
	nominal	Discrete	**Yes**	**Yes**	No
Uniformity	ratio	Continuous	No	No	**Yes**
		Discrete	No	No	**Yes**
	interval	Continuous	No	No	**Yes**
		Discrete	No	No	**Yes**
	ordinal	Discrete	No	No	**Yes**
	nominal	Discrete	**Yes**	**Yes**	**Yes**

"2.3.8 Relation between method of observation of characteristics, scale levels of data and recommended statistical procedures

"2.3.8.1 Established statistical procedures can be used for the assessment of distinctness and uniformity considering the scale level and some further conditions such as the degree of freedom or unimodality (Tables 3 and 4).

"2.3.8.2 The relation between the expression of characteristics and the scale levels of data for the assessment of distinctness and uniformity is summarized in Table 6.

Table 3: Statistical procedures for the assessment of distinctness

Type of Scale	Distribu-tion	Observation method	Procedure	Further Condition	Reference document
ratio	continuous	MS MG (VS) 1)	COYD	at least 10 and preferably at least 20 df[3)**]	TGP/8 and 9
	discrete		long term COYD	df<10	TGP/8
interval	continuous				
	discrete		2x1% method	at least 10 and preferably at least 20 df**	TGP/8
ordinal	discrete	VS	Pearson's Chi-Square test	E_{ij}≥5 [4)]	TGP/8
		VS	Fisher's Exact test	E_{ij}<10	TGP/8
		VS	GLM models Threshold models		
		VG	See also explanation for QN characteristics in TGP/9 sections 5.2.2 and 5.2.3 See explanation for QN characteristics in TGP/9 section 5.2.4		TGP/9
nominal	discrete	(VS) 2)	Pearson's Chi-Square test	E_{ij}≥5	TGP/8
		VS	Fisher's Exact test	E_{ij}<10	TGP/8
		VS	GLM models	E_{ij}≥5	
		VG	See explanation for QL and PQ characteristics in TGP/9 sections 5.2.2 and 5.2.3		TGP/9

"1) see remark in section 2.3.3.8.2 *[cross ref.]*
"2) normally VG but VS would be possible
"3) df – degree of freedom
"4) E_{ij} – expected value of a class

** The draft of document of TGP/8: Part I: DUS Trial Design and Data Analysis New Section 2: "Data to be Recorded" will be considered by the TC in conjunction with the draft revisions of document TGP/8: Part II: Techniques Used in DUS Examination Section 3: "The Combined Over Years Criteria for Distinctness" and Section 4: "2x1% Method" (see documents TC/49/24 and TC/49/26).

Table 4: Statistical procedures for the assessment of uniformity

Type of scale	Distribu-tion	Observation method	Procedure	Further Conditions	Reference document
ratio	continuous	MS	COYU	df≥20	TGP/8 and 10
	discrete				
interval	continuous	MS VS	Relative variance method	$s^2_c \leq 1.47\ s^2$	TGP/8
	discrete				
ordinal	discrete	VS	Threshold model		
nominal	discrete	VS	Off-type procedure for dichotomous (binary) data	Fixed population standard	TGP/8 and 10

"2.4 Different levels to look at a characteristic

"2.4.1 Characteristics can be considered in different levels of process (Table 5). The characteristics as expressed in the trial (type of expression) are considered as process level 1. The data taken from the trial for the assessment of distinctness, uniformity and stability are defined as process level 2. These data are transformed into states of expression for the purpose of variety description. The variety description is process level 3.

"Table 5: Definition of different process levels to consider characteristics

Process level	Description of the process level
1	characteristics as expressed in trial
2	data for evaluation of characteristics
3	variety description

"From the statistical point of view, the information level decreases from process level 1 to 3. Statistical analysis is only applied in level 2.

"2.4.2 Sometimes for DUS experts it seems that there is no need to distinguish between different process levels. The process level 1, 2 and 3 could be identical. However, in general, this is not the case.

"2.4.3 *Understanding the need for process levels*

"2.4.3.1 The DUS expert may know from UPOV Test Guidelines or his own experience that, for example, "Length of plant" is a good characteristic for the examination of DUS. There are varieties which have longer plants than other varieties. Another characteristic could be 'Variegation of leaf blade'. For some varieties, variegation is present and for others not. The DUS expert has now two characteristics and he knows that "Plant: length" is a quantitative characteristic and "Variegation of leaf blade'" is a qualitative characteristic (definitions: see Part I: section 2.2.3 to 2.2.2 *[cross ref.]* below). This stage of work can be described as **process level 1.**

“2.4.3.2 The DUS expert then has to plan the trial and to decide on the type of observation for the characteristics. For characteristic “Variegation of leaf blade”, the decision is clear. There are two possible expressions: “present” or “absent”. The decision for characteristic “Plant length” is not specific and depends on expected differences between the varieties and on the variation within the varieties. In many cases, the DUS expert will decide to measure a number of plants (in cm) and to use special statistical procedures to examine distinctness and uniformity. But it could also be possible to assess the characteristic “Plant length” visually by using expressions like ”short”, “medium” and “long”, if differences between varieties are large enough (for distinctness) and the variation within varieties is very small or absent in this characteristic. The continuous variation of a characteristic is assigned to appropriate states of expression which are recorded by notes (see document TGP/9, section 4*) [cross ref.]*. The crucial element in this stage of work is the recording of data for further evaluations. It is described as **process level 2**.

“2.4.3.3 At the end of the DUS test, the DUS expert has to establish a description of the varieties using notes from 1 to 9 or parts of them. This phase can be described as **process level 3**. For “Variegation of leaf blade” the DUS expert can take the same states of expression (notes) he recorded in process level 2 and the three process levels appear to be the same. In cases where the DUS expert decided to assess “Plant: length” visually, he can take the same states of expression (notes) he recorded in process level 2 and there is no obvious difference between process level 2 and 3. If the characteristic “Plant: length” is measured in cm, it is necessary to assign intervals of measurements to states of expressions like “short”, “medium” and “long” to establish a variety description. In this case, for statistical procedures, it is important to be clearly aware of the relevant level and to understand the differences between characteristics as expressed in the trial, data for evaluation of characteristics and the variety description. This is absolutely necessary for choosing the most appropriate statistical procedures in cooperation with statisticians or by the DUS expert.

"Table 6: Relation between expression of characteristics and scale levels of data for the assessment of distinctness and uniformity

Example	Name of characteristic	Distinctness				Uniformity			
		Unit of assess - ment	Description (states of expression)	Type of scale	Distri-bution	Unit of assess-ment	Description (states of expression)	Type of scale	Distri-bution
1	Sex of plant	1 2 3 4	dioecious female dioecious male monoecious unisexual monoecious hermaphrodite	nominal	discrete	True-type Off-type	Number of plants belonging to the variety Number of off-types	nominal	discrete
2	Leaf blade: variegation	1 9	absent present	nominal	discrete	True-type Off-type	Number of plants belonging to the variety Number of off-types	nominal	discrete
3	Length of plant	cm	assessment in cm without digits after decimal point	ratio	conti-nuous	cm	assessment in cm without digits after decimal point	ratio	conti-nuous
						True-type Off-type	Number of plants belonging to the variety Number of off-types	nominal	discrete
4	Number of stamens	counts	1, 2, 3, ... , 40, 41, ...	ratio	discrete	counts	1, 2, 3, ... , 40, 41, ...	ratio	discrete
5	Time of beginning of flowering	Date	e.g. May 21, 51st day from April 1	interval	discrete	Date	e.g. May 21, 51st day from April 1	interval	discrete
						True-type Off-type	Number of plants belonging to the variety Number of off-types	nominal	discrete

Example	Name of characteristic	Distinctness				Uniformity			
		Unit of assess-ment	Description (states of expression)	Type of scale	Distri-bution	Unit of assess-ment	Description (states of expression)	Type of scale	Distri-bution
6	Intensity of anthocyanin	1 2 3 4 5 6 7 8 9	very low very low to low low low to medium medium medium to high high high to very high very high	ordinal	discrete (with an under-lying quanti-tative variable)	True-type Off-type	Number of plants belonging to the variety Number of off-types	nominal	discrete
7	Shape	1 2 3 4 5 6 7	deltate ovate elliptic obovate obdeltate circular oblate	nominal	discrete	True-type Off-type	Number of plants belonging to the variety Number of off-types	nominal	discrete
8	Flower color	1 2 3 4 5 6 7 8 9 10	dark red medium red light red white light blue medium blue dark blue red violet violet blue violet	nominal	discrete	True-type Off-type	Number of plants belonging to the variety Number of off-types	nominal	discrete

Consequential changes:

To renumber current Section 2: “Validation of Data and Assumptions” in Part I of document TGP/8 to become Section 3;
To renumber current Section 3: “Choice of Statistical Methods for Examining Distinctness” in Part I of document TGP/8 to become Section 4.

Section 5 (New): Reduction of the Size of Trials

To add a new Section 5 as follows (see document TC/49/41 "Report on the Conclusions", paragraph 53):

"CYCLIC PLANTING OF ESTABLISHED VARIETIES TO REDUCE TRIAL SIZE

"1.1 Summary of requirements for application of method

"Cyclic planting of established varieties to reduce trial size is appropriate for use in trials where:

- distinctness is determined by COYD;
- the number of established varieties is excessive for cost or for practical reasons;
- there should be at least 20 degrees of freedom for the MJRA-adjusted varieties-by-years mean square in the adapted COYD analysis of variance. If there are not, then cyclic planting of established varieties should not be used.

"1.2 Summary

"Cyclic planting of the established varieties in trial and analysis by compensated data is a system to reduce DUS trial sizes while maintaining testing stringency. It may be used in trials where distinctness is determined by COYD.

"The system comprises allocating each of the established varieties in trial to one of three series~~,~~ with one series omitted in turn from trial each year[3]. Candidate varieties are included in trial for the three years of their test period plus a fourth year~~.~~ If, after DUS testing, they are granted protection, they join the established varieties in trial, are allocated to a series and are cyclically omitted from trial every third year.

"Distinctness is assessed by applying an adaptation of COYD to the incomplete table of variety characteristic means (candidate and established varieties) in the three year test period. Where data is missing for a variety, it is compensated for by use of two years' data from before the test period. If uniformity is determined by COYU, it may be applied to the incomplete table of variety characteristic standard deviations (candidate and established varieties) in the three year test period. Prior to its adoption, historical data should be used to compare the DUS decisions made based on the cyclic planting system with those based on the existing system.

"1.3 Cyclic Planting of Established Varieties in Trial

"Established varieties in trial are allocated to one of three series One series is omitted cyclically from trial each year (Fig. 1). Thus varieties belonging to Series 1 in Fig. 1 will not be planted in 2010, 2013 or 2016, whereas those in Series 3 will not be planted in 2012, 2015 or 2018. This will result in a smaller trial size as one third of the established varieties are omitted from the trial each year. Each candidate variety is planted in trial and has data recorded on it in each year of a three year test period (2014 to 2016 in Fig. 1 below), after which a DUS decision is taken. Because of a possible lag between final DUS testing and being granted protection, candidate varieties are kept in trial for a fourth year after the three year test period. If granted protection, they will then become an established variety in trial and will enter the cyclic planting system. Thus all newly accepted varieties are initially present in trial for four consecutive years, and all varieties entering trial in the same year follow the same cycle of omissions in future years. Hence candidate varieties that had their final year of DUS testing in 2012 in Fig. 1 are in trial for a fourth year in 2013 and so join the Series 2 established varieties. Candidate varieties final DUS tested in 2013, 2014 and 2015, would join Series 3, 1 and 2 respectively.

"Established varieties are initially allocated to series in a manner to minimize the risk of bias. Other than the initial allocation, the choice of established varieties following each series is

[3] For the purpose of this document, "year" means a "growing cycle".

determined by the candidate varieties entered for trial in earlier years and by which established varieties the applicants choose to withdraw. Although an exactly equal number of established varieties belonging to each series is not essential, it is likely to be beneficial to balance the numbers in each series in the future. This should be done by transferring established varieties between the series by planting them in years when they should be omitted.

Figure 1. **Data patterns and usage for the test period 2014 to 2016**

					TEST PERIOD				
TRIAL YEARS	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Candidate Varieties					X	X	X	*	
Established Varieties									
Series 1		X	X		X	X		*	*
Series 2	O		X	X		X	X		*
Series 3	O	X		X	X		X	*	
New Established Varieties – Assimilation into matrix									
Final DUS tested in 2012 (Series 2)	O	O	X^F	X		X	X		*
Final DUS tested in 2013 (Series 3)		O	X	X^F	X		X	*	
Final DUS tested in 2014 (Series 1)			X	X	X^F	X		*	*
Final DUS tested in 2015 (Series 2)				O	X	X^F	X		*

X Indicates data retrieved using maximum of 4 years for distinctness testing and within the (boxed) test period for uniformity testing

O Indicates data present but not retrieved

F Indicates final DUS test year of new established varieties

* Indicates future inclusion in trial

☐ (within box) Indicates the data used for uniformity testing

"1.3.1 The assessment of distinctness by data compensation

"Conventionally, when using COYD to assess distinctness, it is applied to a complete variety (candidate and established) by test period years matrix of characteristic means. With cyclic planting, this matrix is incomplete for the established varieties. For the assessment of distinctness, where data on an established variety is missing, data held in computer files from earlier years are used to compensate for the loss of data. Due to lack of overlap years with the candidates, the value of back-data is not as high as data from the test period. In the crops to which cyclic planting has been applied to date, to maintain stringency of testing, two years of past data must be included when one year of current data is missing for an established variety. Thus for the 2014 to 2016 test period illustrated in Fig. 1, established varieties in Series 1 would have data from 2011 and 2012 retrieved, those in Series 2 data from 2012 and 2013 and those in Series 3 data from 2011 and 2013. Even where more years of past data are available (marked by an O in Fig. 1), to avoid reducing the stringency of the distinctness test, only the two most recent years are used to compensate for the missing current year. Hence, while data from 2010 and before are available for varieties in Series 2 and 3, such data are not retrieved for the 2014 to 2016 test period.

"Sometimes data on an established variety will be available for a year when its series suggests it would not be present in the trial. Such cases are the fourth year after the three year test period where a candidate variety has become an established variety in trial, or where an established variety is needed for a special test with a problem variety. In this case the established variety would have full data available during the test period and so no historical data would be retrieved for the distinctness testing. Thus for the test period of 2014 to 2016, successful candidate varieties final DUS tested in 2015 would have no historical data retrieved, whereas successful candidate varieties final DUS tested in 2012, 2013 and 2014 would have historical data retrieved.

"1.3.2 Method of analysis for distinctness assessment

"Distinctness is assessed by applying an adaptation of COYD with Modified Joint Regression Analysis (MJRA) applied to data comprising the incomplete table of variety (candidate and established) characteristic means in the three year test period together with the compensating

back-data for established varieties missing during the test period. Details of the method of analysis and an example are given in section 1.7.

"1.3.3 The assessment of uniformity

"Conventionally, when using COYU to assess uniformity, it is applied to a complete variety (candidate and established) by test period years matrix of within variety standard deviations. With cyclic planting, as may be seen from the boxed year by variety combinations in Fig. 1, this matrix is incomplete for the established varieties. COYU is applied to this matrix and no attempt is made to compensate for the incomplete data. This is because COYU consists of pooling over years the within variety standard deviations for all available established varieties while taking into account any relationship between variety means and the standard deviations. This is done to provide a uniformity standard against which to compare the standard deviations of the candidate varieties. Consequently, it is not possible to make a correction for standard deviations from years outside the test period. As a result, only uniformity data from the established varieties within the test period are used to set the uniformity standard for the candidates.

"1.4 Comparison of the cyclic planting system with the existing system

"Prior to adoption of the system of cyclic planting, historical data should be used to compare the DUS decisions made based on the cyclic planting system with those based on the existing system. Providing all established varieties were planted with the existing system, the cyclic planting system can be simulated by allocating established varieties to the series, replacing their data with missing data symbols in the computer files where appropriate, and including the previous years' files from which data are to be retrieved to compensate for this 'missing' data. The distinctness and uniformity decisions that would have been made based on the cyclic planting system can then be compared with those that would have been made based on the existing system. This approach also permits assessment of the number of years of back-data that should be included to compensate for when one year of data in the test period is missing for an established variety.
Note: if the DUSTNT software is being used, a variety can be made to appear missing simply by removal of its AFP number from the "E file". In United Kingdom DUS Herbage trials, when compared with the previous system, the cyclic planting system was found to be slightly less stringent in distinctness testing and slightly more stringent in uniformity testing, with a minimal overall effect on the DUS variety pass rate.

"1.5 Cyclic planting system software

"The DUST program CYCL, has been developed to enable the compensated data to be retrieved, statistically analyzed using MJRA, and the results presented in reports suitable for the assessment of distinctness. Uniformity assessment is based on the data within the test period and uses the DUST program COYU. Both programs are available as part of the DUST9 (MSDOS based) and DUSTNT (Windows NT and 95) versions of the DUST software.

"1.6. Additional technical detail and example of analysis for distinctness assessment

Distinctness is assessed by applying an adaptation of COYD to *n* data values comprising the incomplete table of variety (candidate and established) characteristic means in the three year test period together with the compensating back-data for established varieties missing during the test period. Characteristics are all analyzed by Modified Joint Regression Analysis (MJRA). This scales all the variety effects in a year up or down depending on the year by multiplying the variety effects by a sensitivity for the year.
The MJRA model for the cyclic planting data with n_v varieties in n_y years is as follows:

$$c_{ij} = \mu + y_j + \beta_j v_i + \varepsilon_{ij}$$

where c_{ij} is the value on a characteristic for variety i in year j, $i = 1,\ldots,n_v$ and $j = 1,\ldots, n_y$
μ is the overall mean
v_i is the effect of the ith variety with $\Sigma v_i = 0$
y_j is the effect of the jth year with $\Sigma y_j = 0$
β_j is the sensitivity of year j.
ε_{ij} is a random error associated with variety i in year j

"This model is an adaptation of one proposed by Digby, P (1979) where year effects are scaled for a variety by multiplying them by a variety sensitivity. As the model is non-linear, it cannot be fitted directly to the data, but must be fitted iteratively to obtain estimates of the variety means

and least significant differences (LSD's), which are based on the MJRA-adjusted varieties-by-years mean square and are used to compare the variety means and determine distinctness. The LSD's and the MJRA-adjusted varieties-by-years mean square are on (n - 1 - 2(n_y - 1) - (n_v - 1)) degrees of freedom, which should be at least 20 degrees of freedom.

"1.6.1 Example of distinctness assessment

"Consider the following matrix of n within year variety means c_{ij}. Variety A represents candidate varieties and varieties B, C and D represent the three series of established varieties. The test period is years 4 to 6.

Example data

	Year					
Variety	1	2	3	4	5	6
A	-	-	-	6	2	3
B	-	6	4	-	6	7
C	7	10	-	8	11	-
D	11	-	14	10	-	17

"Model fitting provides final estimates of $\hat{\mu},(\hat{y}_1,...,\hat{y}_6),(\hat{\beta}_1,...,\hat{\beta}_6),(\hat{v}_1,...,\hat{v}_4)$ as 7.862, (-2.12, 0.55, -1.20, -0.12, 1.16, 1.73), (0.91, 1.14, 1.26, 0.36, 1.39, 1.28), (-5.09, -2.12, 1.38, 5.81), from which the following table of means is derived:

	Year						
Variety	1	2	3	4	5	6	Means
A	-	-	-	6	2	3	2.78 = 7.86 + -5.09
B	-	6	4	-	6	7	5.76
C	7	10	-	8	11	-	9.24
D	11	-	14	10	-	17	13.67
Means	5.74	8.42	6.66	7.75	8.92	9.03	
Sensitivities	0.91	1.14	1.26	0.36	1.37	1.39	

"The model fitting also provides standard errors for the means on 1 degree of freedom, which together with the two-tailed 1% critical t-value on 1 degree of freedom, gives the following table of 1% LSD values between all variety pairs:

Variety	A	B	C
B	15.75		
C	18.00	15.64	
D	18.39	15.64	18.83

"Comparison of the 1% LSD between varieties A and D (18.39) with the difference in their means of 10.89 indicates these varieties are not significantly different at the 1% level. Further details of the analysis and the worked example are given in Camlin *et al* (2001).

"Note: the above example serves to illustrate the method, but is on an artificially small dataset. It results in LSD's and the MJRA-adjusted varieties-by-years mean square on 1 degree of freedom. The recommended minimum for use of the method in practice is 20 degrees of freedom.

"1.7 References

"Camlin, M.S., Watson, S., Waters, B.G. and Weatherup, S.T.C. (2001). The potential for management of reference collections in herbage variety registration trials using a cyclic planting system for reference varieties. Plant Varieties and Seeds, 14:1-14.

"Digby,P (1979) Modified joint regression for incomplete variety x environment data. Journal of Agricultural Science 93, Cambridge, 81-86."

PART II: SELECTED TECHNIQUES USED IN DUS EXAMINATION

Section 1.3: The GAIA Methodology: Weighting of characteristics

To amend Section 1.3.1.1 to clarify that there is an assumption that the length of panicle is used as a characteristic (see document TC/47/26 "Report on the Conclusions", paragraph 73):

"1.3.1 Weighting of characteristics

"1.3.1.1 It is important to take account of the correlation between characteristics when weighting. If two characteristics are linked (e.g. plant height including panicle; plant height excluding panicle), it is advisable to use only one of them in GAIA, to avoid double weight. For example, assuming that panicle length is used as a characteristic, it would be advisable to use only plant height including panicle, or plant height excluding panicle."

Section 3: The Combined-Over-Years Criteria for Distinctness (COYD):

To replace Subsection 3.1 with the text as indicated below (see document TC/49/41 "Report on the Conclusions", paragraph 55):

"3.1 Summary of requirements for application of method

"COYD is an appropriate method for assessing the distinctness of varieties where:

"-the characteristic is quantitative;

"-there are some differences between plants (or plots) of a variety;

"-observations are made on a plant (or plot) basis over at least two years or growing cycles, and these should be carried out at a single location;

"-there should be at least 10, and preferably at least 20 degrees of freedom for the varieties-by-years mean square in the COYD analysis of variance, if there are not, then in some circumstances Long-Term COYD can be used whereby additional data from other varieties and earlier years are used and the degrees of freedom for the varieties-by-years mean square is increased correspondingly (see 3.6.2 below);

To replace Subsections 3.5 to 3.5.3 with the text as indicated below (see document TC/49/41 "Report on the Conclusions", paragraph 55):

"3.5 Use of COYD

"3.5.1 COYD is an appropriate method for assessing the distinctness of varieties where:

"-the characteristic is quantitative;

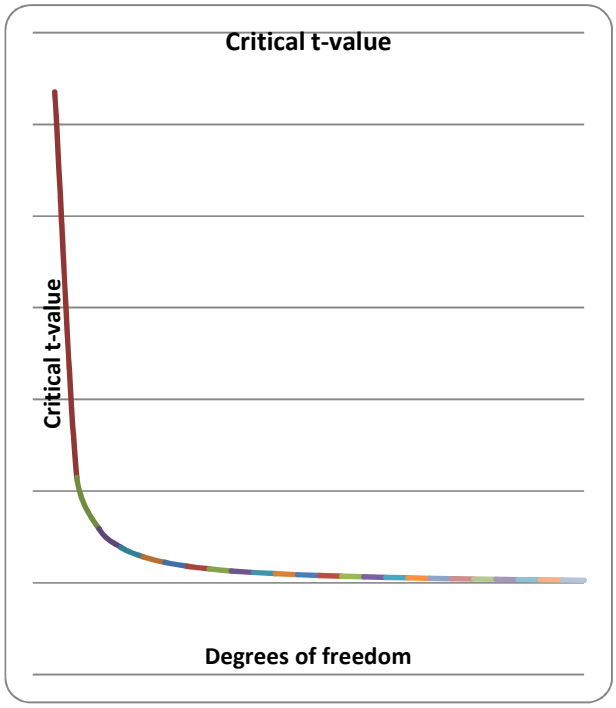
"-there are some differences between plants (or plots) of a variety;

"-observations are made on a plant (or plot) basis over two or more years;

"-there should be at least 10, and preferably at least 20 degrees of freedom for the varieties-by-years mean square in the COYD analysis of variance, if there are not, then in some circumstances Long-Term COYD can be used whereby additional data from other varieties and earlier years are used and the degrees of freedom for the varieties-by-years mean square is increased correspondingly (see 3.6.2 below);

"The reason for this recommendation is to ensure that the varieties-by-years mean square is based on sufficient data to be a reliable estimate of the varieties-by-years variation in the LSD. The fewer the data, the fewer the degrees of freedom for the varieties-by-years mean square, and the less reliable the estimate of the varieties-by-years variation used in the LSD. This is compensated for by use of a larger critical t-

value, t_p, in the LSD. The result is a less powerful test, which means that there is a reduced chance of declaring varieties as being distinct. From the graph below, it can be seen that the power of the test is good with 20 or more degrees of freedom for the varieties-by-years mean square, that it is still reasonably powerful if the degrees of freedom drop to 10, though more is preferable.



"Twenty degrees of freedom corresponds to 11 varieties common in three years of trials, or 21 varieties common in two years, whereas, ten degrees of freedom corresponds to 6 varieties common in three years of trials, or 11 varieties common in two years. Trials with fewer varieties in common over years are considered to have small numbers of varieties in trial.

"3.5.2 A pair of varieties is considered to be distinct if their over-years means differ by at least the COYD LSD in one or more characteristics.

"3.5.3 The UPOV recommended probability level *p* for the t_p value used to calculate the COYD LSD differs depending on the crop and for some crops depends on whether the test is over two or three years. The testing schemes that usually arise in distinctness testing are described in document TGP/8/1 Part II section 3.11.

To replace Subsections 3.6.2 to 3.8 with the text as indicated below (see document TC/49/41 "Report on the Conclusions", paragraph 55):

"3.6.2 Small numbers of varieties in trials: Long-Term COYD

"3.6.2.2 In trials with small numbers of varieties the variety-by-year tables of means can be expanded to include means for earlier years, and if necessary, other established varieties. As not all varieties are present in all years, the resulting tables of variety-by-year means are not balanced. Consequently, each table is analysed by the least squares method of fitted constants (FITCON) or by REML, which produces an alternative varieties-by-years mean square as a long-term estimate of variety-by-years variation. This estimate has more degrees of freedom as it is based on more years and varieties.

$$\text{degrees of freedom} = \begin{pmatrix} \text{No. values in expanded} \\ \text{variety - by - year table} \end{pmatrix} - (\text{No. varieties}) - (\text{No. years}) + 1$$

"3.6.2.3 The alternative varieties-by-years mean square is used in equation [1] above to calculate an LSD. This LSD is known as a "Long-Term LSD" to distinguish it from COYD LSD based on just the test years and varieties. The Long-Term LSD is used in the same way as the COYD LSD is used to assess the distinctness of varieties by comparing their over-year (the test years) means. The act of comparing the means of varieties using a "Long-Term LSD" is known as "Long-Term COYD".

"3.6.2.4 Long-Term COYD should only be applied to those characteristics lacking the recommended minimum degrees of freedom. However, when there is evidence that a characteristic's LSD fluctuates markedly across years, it may be necessary to base the LSD for that characteristic on the current two or three-years of data, even though it has few degrees of freedom.

"3.6.2.5 Figure 2 gives an example of the application of Long-Term COYD to the Italian ryegrass characteristic "Growth habit in spring". A flow diagram of the stages and DUST modules used to produce Long-Term LSD's and perform Long-Term COYD is given in Figure B2 in Part II: section 3.10.

"3.6.2.6 Marked year-to-year changes in an individual variety's characteristic

"Occasionally, a pair of varieties may be declared distinct on the basis of a t-test which is significant solely due to a very large difference between the varieties in a single year. To monitor such situations a check statistic is calculated, called F_3, which is the variety-by-years mean square for the particular variety pair expressed as a ratio of the overall variety-by-years mean square. This statistic should be compared with F-distribution tables with 1 and *g*, or 2 and *g*, degrees of freedom, for tests with two or three years of data respectively where *g* is the degrees of freedom for the variety-by-years mean square. If the calculated F_3 value exceeds the tabulated F value at the 1% level then an explanation for the unusual result should be sought before making a decision on distinctness.

"3.7 Implementing COYD

"COYD is an appropriate method for assessing the distinctness of varieties where:

"- the characteristic is quantitative;

"- there are some differences between plants (or plots) of a variety;

"- observations are made on a plant (or plot) basis over two or more years;

"- there should be at least 10, and preferably at least 20 degrees of freedom for the varieties-by-years mean square in the COYD analysis of variance, or if there are not, then Long-Term COYD can be used (see 3.6.2 above) ;

"The COYD method can be applied using TVRP module of the DUST package for the statistical analysis of DUS data, which is available from Dr. Sally Watson (Email: *info@afbini.gov.uk*) or from *http://www.afbini.gov.uk/dustnt.htm.* Sample outputs are given in Part II section 3.10.

"3.8 References

"DIGBY, P.G.N. (1979). Modified joint regression analysis for incomplete variety x environment data. J. Agric. Sci. Camb. 93, 81-86.

"PATTERSON, H.D. & WEATHERUP, S.T.C. (1984). Statistical criteria for distinctness between varieties of herbage crops. J. Agric. Sci. Camb. 102, 59-68.

"TALBOT, M. (1990). Statistical aspects of minimum distances between varieties. UPOV TWC Paper TWC/VIII/9, UPOV, Geneva."

Subsection 3.6.3 (New): Adapting COYD to Special Circumstances

To add a new Subsection 3.6.3 as follows (see document TC/47/26 "Report on the Conclusions", paragraph 57):

"3.6.3 Crops with grouping characteristics

"3.6.3.1 In some crops, it is possible to use grouping characteristics to define groups of varieties such that all the varieties within a group will be distinct from all the varieties of any other group ("distinct groups"). This grouping may be preserved in trial layouts so that, within a replicate, varieties in the same group are in the same vicinity. (See TG/1/3, section 4.8 "Functional Categorization of Characteristics).

"3.6.3.2 When grouping is possible, such that all the varieties within a group will be distinct from all varieties of any other group, comparisons are only necessary between varieties in the same group. Since varieties within groups tend to be more similar to each other, it is possible to tailor the COYD method by accounting for the groups. If there is a sufficient number of varieties in each group, COYD can be applied separately for each group. However, in practice some groups will generally have too few varieties. In such cases, the over-years analysis of variance (COYD) can be adjusted to take into account the grouping. This method is known as COYD for groups (COYDG).

"3.6.3.3 Whereas the standard COYD analysis of variance has terms for 'year' and 'variety', COYDG has terms for 'year', 'group', 'variety-within-group' and 'group-by-year'. The LSD is then calculated for comparisons between pairs of varieties within the same group. It is assumed that the same standard error is applicable within all groups. Note that a larger LSD will apply for comparisons between pairs of varieties from different groups.

"3.6.3.4 So the LSD for COYDG is given by $LSD_p = t_p \times SED_G$

where SED_G is the standard error for the difference between two varieties within the same group and calculated as:

$$SED_G = \frac{\sqrt{2 \times \text{varieties} - \text{within} - \text{group - by- years mean square}}}{\text{number of test years}}$$

"Note that the varieties-within group-by-years mean square is the same as the residual mean square from the COYDG analysis of variance.

"3.6.3.5 The COYDG LSD is used in place of the COYD LSD as a distinctness criterion. Usually it should be smaller. However it is sensible to verify whether this is true on historical data sets.

"3.6.3.6 The COYDG method can be applied using GTVRP module of the DUST package for the statistical analysis of DUS data, which is available from Dr. Sally Watson (Email: *info@afbini.gov.uk*) or from *http://www.afbini.gov.uk/dustnt.htm."*

Section 4: 2x1% Method

To replace Section 4 with the following text (see document TC/47/26 "Report on the Conclusions", paragraph 59):

"4. 2X1% METHOD

"4.1 Requirements for application of method

"4.1.1 The 2x1% Criterion is an appropriate method for assessing the distinctness of varieties where:

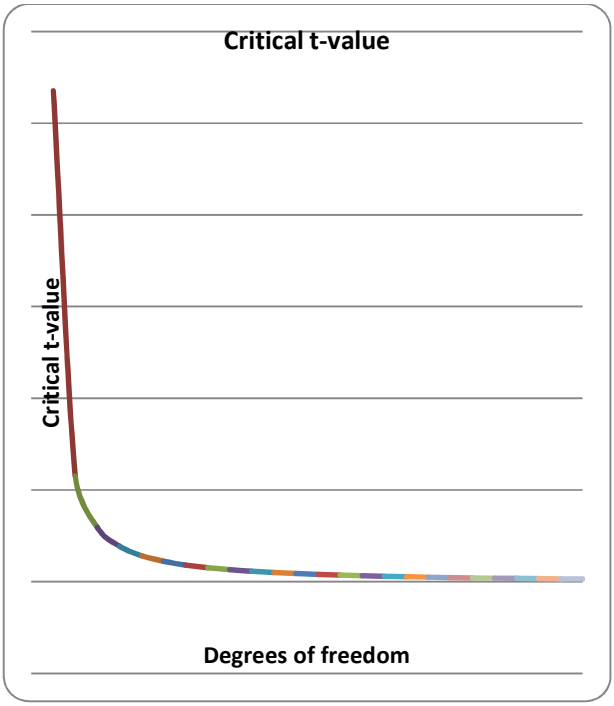
- the characteristic is quantitative;
- there are some differences between plants (or plots) of a variety;
- observations are made on a plant (or plot) basis over two or more years;
- there are at least 10, and preferably at least 20, degrees of freedom for the residual mean square used to estimate the standard error in the t-test in each year;
- To have replicated plots

"4.2 The 2x1% Criterion (Method)

"4.2.1 For two varieties to be distinct using the 2x1% criterion, the varieties need to be significantly different in the same direction at the 1% level in at least two out of three years in one or more measured characteristics. The tests in each year are based on Student's two-tailed t--test of the differences between variety means with standard errors estimated using the residual mean square from the analysis of the variety x replicate plot means.

"4.2.2 With respect to the 2x1% criterion, compared to COYD, it is important to note that:

- "Information is lost because the criterion is based on the accumulated decisions arising from the results of t-tests made in each of the test years. Thus, a difference which is not quite significant at the 1% level contributes no more to the separation of a variety pair than a zero difference or a difference in the opposite direction. For example, three differences in the same direction, one of which is significant at the 1% level and the others at the 5% level would not be regarded as distinct.
- "Some characteristics are more consistent over years than others in their expression of differences between varieties. However, beyond requiring differences to be in the same direction in order to count towards distinctness, the 2x1% criterion takes no account of consistency in the size of the differences from year to year.
- "It is recommended that there should be at least 10, and preferably at least 20, degrees of freedom for the residual mean square used to estimate the standard error in the t-test in each year. This is to ensure that the residual mean square is based on sufficient data to be a reliable estimate of the varieties-by-replicates variation used in the standard error in the t-test. The fewer the data, the fewer the degrees of freedom for the residual mean square, and the less reliable the estimate of the standard error in the t-test. This is compensated for by use of a larger critical t-value in the t-test. The result is a less powerful test, which means that there is a reduced chance of declaring varieties as being distinct. From the graph below, it can be seen that the power of the test is good with 20 or more degrees of freedom for the residual mean square, that it is still reasonably powerful if the degrees of freedom drop to 10, though more is preferable.



"Assuming replicates are arranged in blocks, 20 degrees of freedom corresponds to 11 varieties in three replicates, or 5 varieties in six replicates, whereas, ten degrees of freedom corresponds to 6 varieties in three replicates, or 3 varieties in six replicates."

[Annex III follows]

ANNEX III

REVISION OF DOCUMENT TGP/9: MATTERS APPROVED BY THE TC

TABLE OF CONTENTS

Section 2.5.2 (New): Providing Photographs with the Technical Questionnaire

To insert new guidance after Section 2.5.2 as follows (see document TC/49/41 "Report on the Conclusions", paragraph 47):

"Guidance for applicants on providing suitable photographs of the candidate variety as accompaniment to the Technical Questionnaire

"Introduction

"The taking of photographs of candidate varieties is influenced by factors, such as light conditions, quality and setting of the camera, and the background. The perception of the photograph can also be affected by the quality, settings and resolution of the screen and printout or developed photographs. It is not possible to standardize all conditions when photos are taken in different premises but this document aims to provide guidance in order to provide meaningful and coherent information on the candidate variety, while on the one side decreasing the influence of the origin of the photograph (location, equipment, etc), and on the other side making the relevant authorities aware of possible influences to be taken into account when making use of the photographs provided. By decreasing the influence of these external factors on the taking of photographs, it will in particular help to ensure that "color", the trait most liable to be affected by such factors, will be reliably represented in photographs provided by applicants.

"Criteria for taking photographs

"Format

"Photographs must be in color and submitted either in print form of at least 10cm x 15 cm, and/or as an electronic photo in a frequently used format such as jpeg (minimum 960x1280 pixels). The photograph must be well focused and aim to have the plants or plant parts occupy as much of the frame of the photograph as possible. It should be noted that different makes/models of computer screens can influence the expression of the color and the advantage of a printout is that the applicant can make a comment, e.g. actual color darker, and the examination authority would see exactly the same printout. Conversely, the advantages of having an image in an electronic format are that this could display the camera type and settings, date and GPS location of the taken photo, the possibility to exchange the image instantaneously via electronic means, and the possibility to store the image indefinitely electronically without a reduction in quality.

"Best time for taking photographs

"Photographs must illustrate plants of the candidate variety at the stage when the distinguishing features of the variety are most apparent. Often this is when the plants are fully developed and at the stage when they are of commercial value (e.g. flowering for many ornamentals, fruiting for many fruit species), which usually corresponds to the most numerous set of characteristics in the corresponding UPOV guideline for the species in question.

"Photographic environment

"Photographs should be taken under adequate light conditions and with an appropriate background. It is preferable to have photographs taken indoors, since one can ensure homogenous photographic conditions irrespective of the type of photographs and number of candidate varieties supplied by the same applicant. The background of the photograph should be neutral (e.g. off-white in case of dark colors or grey in case of light colors) and should not have a shiny surface. If the photograph is taken indoors, then this should preferably be done in the same room and under artificial light conditions which will ensure identical and ample luminosity on repeated occasions over time. If a photograph has to be taken outdoors, then this should not be in direct sunlight but in a shaded area with as much indirect natural light as possible or on a cloudy day.

"Specification of growing conditions

"The applicant should provide information on the date and location of the photograph taken. The plants of the candidate variety appearing in the photographs should have been grown under standard growing conditions for the crop in question, or under any specific conditions as may have been indicated for the candidate variety in the Technical Questionnaire (e.g. indoor, outdoor, season of the year). If this is not the case, then any possible alteration in the expression of the characteristic(s) appearing in the photographs must be specified (e.g. seasonal conditions may influence the color and pattern of fruit and flowers, such as over coloring in apple according to outdoor light intensity and night temperatures, delphinium grown either outdoors or indoors).

"Plant organs to be displayed

"The photographs should show the plant parts which are a distinguishing feature of the candidate variety, as well as those of the whole plant and the most important commercial organs (flower, fruit, etc.). If the distinguishing features of the candidate variety are very specific (e.g. seed size, shape of leaf/flower/fruit, length of awns, color pattern of flower/fruit, etc.) it is recommended to remove these plant parts from the plant and take a well-focused close-up photograph of them. For some crops (e.g. peach, tomato), a photograph of a mass view of several harvested fruit in an industry-standard tray can provide of valuable illustration of the candidate variety.

"Similar varieties

"Although not a requirement, the applicant may wish to illustrate differences between the candidate variety and the variety thought to be the most similar as nominated by him/her under point 6 of the Technical Questionnaire, by providing photographs of the candidate variety alongside the aforesaid similar variety. In such photographs, the distinguishing plant parts of the candidate variety should be photographed alongside the same plant parts of the nominated similar variety(ies). Where there is more than one similar variety named by the applicant, a separate photograph of the relevant plant parts of the candidate variety and each of those of the similar varieties could be provided.

"Labeling

"A photograph must be clearly labeled with the breeder's reference and/or (proposed) variety denomination of the candidate variety; trade names may be used only in addition to the breeder's reference and/or (proposed) variety denomination.

"Metric scales

"A metric scale in centimeters – also millimeters where a close-up photograph has been taken – should ideally appear along the horizontal and/or vertical margins of the photograph. .

"Color characteristics

"For ornamental species, reference to the relevant RHS Colour Chart placed alongside the pertinent plant organ (e.g. flower) provides greater precision. For other crop sectors, industry-

recognized color charts can also be displayed alongside the pertinent plant organ (e.g. apple fruit). Likewise, the color itself of the plant organ may not be the most representative feature of the candidate variety but rather the color pattern (e.g. pattern of over color in apple fruit, stripes/spots/netting in *Phalaenopsis*), and this can be well illustrated in a clear and well focused photograph."

Section 5.5 (New): Guidance on Number of Plants to be Examined (for Distinctness)

To add new Section 5.5 as follows (see document TC/49/41 "Report on the Conclusions", paragraph 84):

"Number of Plants / Parts of Plants to be Examined (for distinctness)

"1. The observation of the '*typical*' expression of characteristics of a variety in a given environment is essential for the assessment of distinctness. The precision of the observed (mean) expression of the varieties to be compared is a critical element for the consideration of whether a difference is a clear difference.

"2. In the case of qualitative characteristics, a low number is sufficient to identify the expression of a variety. In general, the number of plants for the assessment of distinctness is not a limiting factor for the number of plants in the trial. Thus, the number of plants for the assessment of qualitative characteristics is not essential for harmonization.

"3. In case of quantitative characteristics (and pseudo-qualitative characteristics), the variation within the variety has to be taken into account for defining a clear difference (by expert judgment or exact statistics). Due to the relation between variation within the varieties and the required difference to be considered as a clear difference for the establishment of distinctness the precision of records is important. The precision of records (mean values) is influenced by the sample size. Therefore, the appropriate sample size should be indicated in the Test Guidelines for the purpose of harmonization.

"4. The following general principals should be taken into account:

"*Considerations for the number of plants to be observed for distinctness in case of QN (*in some cases *PQ)*

(a) Observation on the plot as a whole (VG/MG)
– the indicated number should be considered as minimum number

(b) Observation on subsample from plot (VG/MG)
– the indicated number should be considered as minimum number

(c) Observations on individual plants (VS/MS)
– the number of plants is important for precision of record
– the specific number should be indicated

"*Considerations for the number of plants for candidate varieties and varieties to be compared with the candidate varieties*

"5. The required precision of records depends on the size of the difference between the candidate variety and the varieties of common knowledge. If two varieties are very similar it is important to ensure the same precision of the records for both varieties. The number of plants indicated in the Test Guidelines applies to both the candidate variety and the similar variety of common knowledge. In other cases, it may be possible to include in the trial a lower number of plants for the variety of common knowledge, provided that uniformity does not have to be assessed for that variety, i.e. varieties in the variety collection."

[Annex IV follows]

ANNEX IV

See Excel spreadsheet.

[Appendices follow]

See Excel spreadsheet.

[Appendix II follows]

See Excel spreadsheet.

[End of Appendix II and of document]