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UPOV

INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS

GENEVA

DRAFT

Associated Document
to 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)

DOCUMENT TGP/10

"EXAMINING UNIFORMITY"

Document prepared by the Office of the Union

to be considered by the Enlarged Editorial Committee at its meeting
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SECTION 1: INTRODUCTION

1.1 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), hereinafter referred to as "the General Introduction", states, with respect to uniformity (see Chapter 6), that:

> "6.1 Requirements of the UPOV Convention
>
> According to Article 6(1)(c) of the 1961/1972 and 1978 Acts of the UPOV Convention, a variety is deemed uniform if it is "sufficiently homogeneous, having regard to the particular features of its sexual reproduction or vegetative propagation." Article 8 of the 1991 Act deems that a variety is uniform if, "subject to the variation that may be expected from the particular features of its propagation, it is sufficiently uniform in its relevant characteristics," thereby making it clear that characteristics are the basis for examination of uniformity.
>
> 6.2 Relevant Characteristics
>
> At least for the purposes of the 1991 Act of the UPOV Convention it is necessary to clarify the meaning of relevant characteristics. Relevant characteristics of a variety include at least all characteristics used for the examination of DUS or included in the variety description established at the date of grant of protection of that variety. Therefore, any obvious characteristic may be considered relevant, irrespective of whether it appears in the Test Guidelines or not.
>
> 6.3 Level of Uniformity According to the Particular Features of Propagation
>
> The UPOV Convention links the uniformity requirement for a variety to the particular features of its propagation. This means that the level of uniformity required for truly self-pollinated varieties, mainly self-pollinated varieties, inbred lines of hybrid varieties, vegetatively propagated varieties, cross-pollinated varieties, mainly cross-pollinated varieties, synthetic varieties and hybrid varieties will, in general, be different."

1.2 The variation in the expression of characteristics within varieties is the critical consideration in the assessment of uniformity. This variation has both genotypic and environmental components. The level of environmental variation depends on the interaction between individual plants and the environment and is influenced by the type of expression of the characteristic. For quantitative and pseudo-qualitative characteristics, the level of environmental variation can differ from species to species and from characteristic to characteristic. There is usually little environmental variation for qualitative characteristics. The genotypic component is mainly influenced by the features of propagation. As noted in 1.1 above *[cross ref.]*, Article 8 of the 1991 Act of the UPOV Convention requires consideration of the uniformity of a variety on the basis of "… the variation that may be expected from the particular features of its propagation, …". With regard to the particular features of propagation:

(a) a low level of genotypic variation is expected for vegetatively propagated and truly self-pollinated varieties. Variation in the expression of characteristics within such varieties should result, predominantly, from environmental influences;

(b) variation in the expression of characteristics within mainly self-pollinated varieties should also result, predominantly, from environmental influences but a low level of genotypic variation caused by some cross pollination is accepted. Therefore, more variation may be tolerated than for vegetatively propagated and truly self-pollinated varieties;

(c) in cross-pollinated varieties (including synthetic varieties) variation in the expression of characteristics within varieties results from both genotypic and environmental components. In relation to self-pollinated, vegetatively propagated and mainly self-pollinated varieties a higher genotypic variation is accepted. The overall level of variation is, therefore, generally higher in cross-pollinated and synthetic varieties;

(d) genotypic variation in hybrid varieties depends on the type of hybrid (single- or multiple-cross), the level of genotypic variation in the parental lines (inbred lines or others) and the system for hybrid seed production (mechanical emasculation, system of male sterility etc.). The tolerance limits for uniformity are set according to the specific situation resulting from genotypic and environmental influences on the variation in the expression of characteristics.

~~The type of variation in the expression of characteristics within varieties determines how that characteristic is used to determine uniformity in the crop (off-types in case of discontinuous variation or standard deviations in case of continuous variation of characteristics). Thus, the uniformity of the crop may be determined by off-types alone, by standard deviations of the characteristics alone, or by off-types for some characteristics and by standard deviations for other characteristics.~~

1.3 The General Introduction (see Chapter 6), explains the following with respect to methods for the examination of uniformity:

> *"6.4 Methods for the Examination of Uniformity*
>
> Where all the plants of a variety are very similar, and in particular for vegetatively propagated and self-pollinated varieties, it is possible to assess uniformity by the number of obviously different plants – "off-types" – that occur. However, where the range of variation within a variety is larger, because of the features of its propagation, and in particular for cross-pollinated, including synthetic, varieties, the plants are not all very similar and it is not possible to visualize which plants should be considered as atypical or "off-types." In this case the uniformity can be assessed by considering the overall range of variation, observed across all the individual plants, to determine whether it is similar to comparable varieties. These two general approaches are explained below:"

1.4 In cases where it is possible to "visualize" off-types, the off-type approach is recommended for the assessment of uniformity.

1.5 The following two sections consider the assessment of uniformity by the off-type approach and by considering the overall range of variation to determine whether it is similar to comparable varieties, or "relative tolerance limits", approach.

SECTION 2: UNIFORMITY ASSESSMENT ON THE BASIS OF OFF-TYPES

2.1 Introduction

The General Introduction (Chapter 6.4) states that "Where all the plants of a variety are very similar, and in particular for vegetatively propagated and self-pollinated varieties, it is possible to assess uniformity by the number of obviously different plants – "off-types" – that occur." This section considers the use of the off-type approach.

2.2 Method of observation (Visual / Measurement)

2.2.1 The General Introduction states the following with respect to the observation of characteristics for uniformity using the off-type procedure:

> "6.4.1 Self-Pollinated and Vegetatively Propagated Varieties
>
> *6.4.1.1 Determination of Off-Types by Visual Assessment*
>
> A plant is to be considered an off-type if it can be clearly distinguished from the variety in the expression of any characteristic of the whole or part of the plant that is used in the testing of distinctness, taking into consideration the particular features of its propagation. This definition makes it clear that, in the assessment of uniformity, the standard for distinctness between off-types and a candidate variety is the same as for distinctness between a candidate variety and other varieties (see Chapter 5, section 5.5.2).
>
> *6.4.1.2 Determination of Off-Types Using Measurements*
>
> Most characteristics of self-pollinated and vegetatively propagated varieties are observed visually, or by making a single measurement in a group of plants. However, where appropriate, methods of handling measurements from individual plants, in order to assess off-types in truly or mainly self-pollinated varieties and vegetatively propagated varieties, are set out in document TGP/10, "Examining Uniformity.""

2.2.2 As with the observation of characteristics for distinctness (see document TGP/9 Section 4.1.4 *[cross ref.]*), qualitative and pseudo-qualitative characteristics are, in general, observed visually and off-types are determined by visual assessment. For vegetatively propagated and self-pollinated varieties there is very little variation within varieties and, as with the observation of characteristics for distinctness for such varieties, quantitative characteristics are commonly observed visually, with off-types being determined by visual assessment. In some cases, measurements are taken from individual plants in order to assess off-types for quantitative characteristics. The use of visual observation and measurements for determining off-types is considered below.

2.3 Determination of Off-types

Section on "Criteria for determining off-types" to be developed[a]

2.3.1 Determination of off-types by visual assessment

2.3.2 Determination of off-types using measurements

~~If off-types cannot be detected visually, uniformity must be assessed on the basis of standard~~

~~deviations. In some cases it may be appropriate to detect off-types in measurements taken from individual plants. Guidance for such procedures is given in section 10.3.x.~~

guidance on "methods of handling measurements from individual plants, in order to assess off-types in truly or mainly self-pollinated varieties and vegetatively propagated varieties" to be developed?

2.4 Acceptable number of off-types

2.4.1 The General Introduction states the following with respect to setting the acceptable number of off-types:

> "6.4.1 Self-Pollinated and Vegetatively Propagated Varieties
> […]
> *6.4.1.3 Statistical Basis for Setting Numbers of Off-Types*
>
> The acceptable number of off-types tolerated in samples of various sizes is often based on a fixed "population standard" and "acceptance probability." The "population standard" can be expressed as the percentage of off-types to be accepted if all individuals of the variety could be examined. The probability of correctly accepting that a variety is uniform is called the "acceptance probability." Based on statistical calculations for "population standards" and "acceptance probabilities," the recommended "population standard" and "acceptance probability" are stated in the individual Test Guidelines. The Test Guidelines also recommend the maximum number of off-types tolerated for a given sample size. More detailed information can be found in document TGP/10, "Examining Uniformity."
>
> 6.4.1.3.1 Vegetatively Propagated and Truly Self-Pollinated Varieties
>
> Document TGP/10, "Examining Uniformity," sets out the acceptable number of off-types tolerated in samples of various sizes based on a specified "population standard" and "acceptance probability."
>
> 6.4.1.3.2 Mainly Self-Pollinated Varieties and Inbred Lines of Hybrid Varieties
>
> For the purpose of DUS testing, mainly self-pollinated varieties are those that are not fully self-pollinated but are treated as self-pollinated for testing. For these, as well as for inbred lines of hybrid varieties, a higher tolerance of off-types can be accepted, compared to truly self-pollinated and vegetatively propagated varieties. This is explained further in document TGP/10, "Examining Uniformity.""

2.4.2 The Test Guidelines, where available, recommend a general, i.e. "fixed", population standard and acceptance probability as well as the acceptable number of off types for a given sample size. The [~~absolute~~ population standard is] / [population standard and acceptance probability are] fixed on the basis of experience.

2.4.3 In the absence of Test Guidelines (see TGP/13) [or in cases where the number of comparable varieties is very low and may not be representative for that type of variety], an appropriate ~~absolute~~ population standard is fixed on the basis of experience.

- meaning of "experience" to be clarified, including guidance on setting a higher population standard for mainly self-pollinated varieties

2.4.4 Detailed guidance on the use of off-type approach, including tables of maximum numbers of off-types for given sample sizes corresponding to fixed population standards and acceptance probabilities, is provided in document TGP/8 Section 3 *[cross ref.]*.

SECTION 3: UNIFORMITY ASSESSMENT ON THE BASIS OF [STANDARD DEVIATIONS] / [RELATIVE TOLERANCE LIMITS]

3.1 Introduction

3.1.1 The General Introduction (see Chapter 6), explains the following with respect to the examination of uniformity:

> *"6.4 Methods for the Examination of Uniformity*
>
> Where all the plants of a variety are very similar, and in particular for vegetatively propagated and self-pollinated varieties, it is possible to assess uniformity by the number of obviously different plants – "off-types" – that occur. However, where the range of variation within a variety is larger, because of the features of its propagation, and in particular for cross-pollinated, including synthetic, varieties, the plants are not all very similar and it is not possible to visualize which plants should be considered as atypical or "off-types." In this case the uniformity can be assessed by considering the overall range of variation, observed across all the individual plants, to determine whether it is similar to comparable varieties. […]"
> […]
> 6.4.2 Cross-Pollinated Varieties
>
> Cross-pollinated varieties, including mainly cross-pollinated and synthetic varieties, generally exhibit wider variations within the variety than vegetatively propagated or self-pollinated varieties and inbred lines of hybrid varieties, and it is more difficult to determine off-types. Therefore, relative tolerance limits, for the range of variation, are set by comparison with comparable varieties, or types, already known. This means that the candidate variety should not be significantly less uniform than the comparable varieties. For more detailed information and guidance on setting standards for new types and species, see documents TGP/10, "Examining Uniformity" and TGP/13, "Guidance for New Types and Species.""

3.1.2 In this section, the approach of using relative tolerance limits, for the range of variation, set by comparison with comparable varieties, or types, already known is referred to as the "relative tolerance limits" approach.

3.2 Method of observation (Visual / Measurement)

3.2.1 As with the observation of characteristics for distinctness (see document TGP/9 Section 4.1.4 *[cross ref.]*), qualitative and pseudo-qualitative characteristics are, in general, observed visually. (See Section 3.3.1 *[cross ref.]*).

3.2.2 In the case of the relative tolerance limits approach, the choice of visual observation or measurements for quantitative characteristics, may take into account the following factors…

3.3 Determining the acceptable level of variation

3.3.1 Visually observed characteristics

3.3.1.1 The General Introduction states the following with respect to assessment of uniformity based on visually observed characteristics in cross-pollinated varieties:

"6.4.2 Cross-Pollinated Varieties
[…]
6.4.2.1 Visually Observed Characteristics

For characteristics that are recorded by visual observation of single plants, the acceptable level of variation for the variety should not significantly exceed the level of variation found in comparable varieties already known. For more details on the handling of uniformity of visually assessed characteristics, see document TGP/10, "Examining Uniformity."

more details to be developed to cover qualitative and pseudo-qualitative characteristics?

3.3.2 Measured characteristics

3.3.2.1 The General Introduction states the following with respect to assessment of uniformity based on measured, quantitative characteristics in cross-pollinated varieties:

"6.4.2 Cross-Pollinated Varieties
[…]
6.4.2.2 Measured Characteristics

6.4.2.2.1 For measured characteristics, the acceptable level of variation for the variety should not significantly exceed the level of variation found in comparable varieties already known. UPOV has proposed several statistical methods for dealing with uniformity in measured quantitative characteristics. One method, which takes into account variations between years, is the Combined Over Years Uniformity (COYU) method.

6.4.2.2.2 For more details on the handling of uniformity in measured quantitative characteristics, see document TGP/10, "Examining Uniformity"."

3.3.2.2 The comparison between a candidate variety and comparable varieties is carried out on the basis of standard deviations calculated from individual plant observations.

3.3.2.3 If the conditions for the application of the Combined-Over-Years Uniformity Criterion (COYU) procedure are fulfilled, COYU is a suitable statistical method for this comparison. This procedure calculates a tolerance limit on the basis of comparable varieties already known i.e. uniformity is assessed using a relative tolerance limit based on varieties within the same trial with comparable expression of characteristics.

3.3.2.4 Details of the COYU method are provided in document TGP/8 Section 2.2 *[cross ref.]*.

3.3.2.5 If the conditions for the application of the COYU procedure are not fulfilled e.g. the test is performed for only one year or the number of tested varieties is too small, other appropriate statistical methods should be used for the comparison of standard deviations (e.g. 1.6 × variance, long term LSD). [Australia to provide examples of both methods]

3.3.3 Setting standards for new types and species

to be provided in accordance with General Introduction Chapter 6.4.2 (see above)

SECTION 4: UNIFORMITY ASSESSMENT FOR HYBRID VARIETIES

4.1 The General Introduction (see Chapter 6), explains the following with respect to the assessment of uniformity for hybrid varieties:

> "6.4.3 Assessment of Uniformity in Hybrid Varieties
>
> *6.4.3.1 General*
>
> 6.4.3.1.1 The assessment of uniformity in hybrid varieties depends on the type of hybrid, i.e. whether it is a single-cross hybrid or another type, and whether it is a hybrid resulting from inbred parent lines, vegetatively propagated lines, or from cross-pollinated parents.
>
> 6.4.3.1.2 The uniformity and stability of a hybrid variety may be assessed by examining the uniformity and stability of the hybrid itself or, under certain conditions, that of the progenitors and the hybrid.
>
> *6.4.3.2 Single-Cross Hybrid Varieties Resulting from Inbred Parent Lines*
>
> Single-cross hybrid varieties resulting from inbred lines are treated as mainly self-pollinated varieties. However, an additional tolerance is allowed for the occurrence of self-pollinated inbred parent plants. It is not possible to fix a percentage, as decisions differ according to the species and the method of propagation. However, the percentage of such plants should not be so high as to interfere with the trials. Where appropriate, a maximum number will be set in the Test Guidelines.
>
> *6.4.3.3 Single-Cross Hybrid Varieties Not Resulting Exclusively From Inbred Parent Lines*
>
> For hybrid varieties resulting from at least one cross-pollinated parent, relative tolerance limits should be used, and they should be treated as cross-pollinated or synthetic varieties as long as no other proof is given.
>
> *6.4.3.4 Multiple-Cross Hybrid Varieties*
>
> 6.4.3.4.1 For other than single-cross hybrids (e.g. three-way crosses or double crosses), a segregation of certain characteristics is acceptable if it is compatible with the method of propagation of the variety. Therefore, if the heredity of a clear-cut segregating characteristic is known, it is required to behave in the predicted manner. If the heredity of the characteristic is not known, it is treated in the same way as other characteristics in cross-pollinated varieties, i.e. relative tolerance limits, for the range of variation, are set by comparison with comparable varieties, or types, already known (see section 6.4.2).
>
> 6.4.3.4.2 For setting a tolerance for the occurrence of self-pollinated parent plants, the same considerations apply as for a single-cross hybrid variety (see section 6.4.3.2)."

4.2 The case of multiple-cross varieties with a segregation of certain characteristics is considered further in Section 5 *[cross ref.]*.

SECTION 5: SEGREGATING CHARACTERISTICS IN HYBRID AND SYNTHETIC VARIETIES

5.1 The General Introduction explains the following with respect to the assessment of uniformity for hybrid varieties with a segregation for certain characteristics:

> *6.4.3.4 Multiple-Cross Hybrid Varieties*
>
> 6.4.3.4.1 For other than single-cross hybrids (e.g. three-way crosses or double crosses), a segregation of certain characteristics is acceptable if it is compatible with the method of propagation of the variety. Therefore, if the heredity of a clear-cut segregating characteristic is known, it is required to behave in the predicted manner. If the heredity of the characteristic is not known, it is treated in the same way as other characteristics in cross-pollinated varieties, i.e. relative tolerance limits, for the range of variation, are set by comparison with comparable varieties, or types, already known (see section 6.4.2).

5.2 For multiple-cross hybrids and synthetic varieties, a segregation of certain characteristics, in particular qualitative characteristics, is accepted if it is compatible with the expression of the parental lines and the method of propagating the variety. If the inheritance of a segregating characteristic is known, the variety is considered to be uniform if the characteristic behaves in the predicted manner.

5.3 If the inheritance of a clear-cut segregating characteristic is not known, the observed segregation ratio should be described.

5.4 In quantitative characteristics, segregation in multiple-cross hybrids [and synthetic varieties?] may result in a continuous variation. In such cases uniformity is assessed as in cross-pollinated varieties on the basis of relative tolerance limits for the range of variation, set by comparison with comparable varieties, or types, already known.

SECTION 6: SUMMARY

The following table summarizes the common method of observation and approach for the assessment of uniformity, although there may be exceptions:

	Type of expression of characteristic		
Method of propagation of the variety	QL	PQ	QN
Vegetatively propagated	Visual: Off-types	Visual: Off-types	Visual / Measurement: Off-types
Self-pollinated	Visual: Off-types	Visual: Off-types	Visual / Measurement: Off-types
Cross-pollinated	Visual: Relative tolerance limits	Visual: Relative tolerance limits	Visual / Measurement: Relative tolerance limits (e.g. COYU)
Synthetic varieties	*	*	*
Hybrids	**	**	**

* as for cross-pollinated varieties except for segregating characteristics (see Section 5)
** to be considered according to the type of hybrid (see Sections 5 and 6).

[End of document]

[a] The TWO agreed that guidance on the determination of off-types would be an important part of TGP/10 "Examining Uniformity" and agreed to try to develop such guidance on the basis of document TWF/36/7-TWO/38/9. In order to incorporate guidance within TGP/10, it was recognized that the document would need to be substantially advanced before the thirty-ninth session of the TWO and that that would only be possible by the establishment of a sub-group (Off-type Subgroup) which would comment on interim drafts. The TWO agreed that Mr. Chris Barnaby (New Zealand) should be responsible for preparing drafts with the assistance of the Office where requested. A first draft would be circulated to the Off-type Subgroup before the end of 2005, with comments to be made by the end of January 2006. A second draft would then be circulated by the end of May 2006 with comments to be made by the end of June 2006, followed by preparation of a draft for the thirty-eighth session of the TWO. Offers to participate in the Off-type Subgroup were received from Australia, Canada, CPVO, Denmark, France, Germany, Israel, the Netherlands and the United Kingdom.