E

TGP/10/1 Draft 3
ORIGINAL: English
DATE: February 3, 2006

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 Technical Committee at its forty-second session
to be held in Geneva, from April 3 to 5, 2006

TABLE OF CONTENTS

SECTION 1: INTRODUCTION

1.1 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".

1.2 The General Introduction (Chapter 6: Section 6.2) clarifies that "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".

1.3 This document explains how the variation in the expression of relevant characteristics within varieties is used as the basis for the assessment of uniformity and provides an overview of the two main approaches to the assessment of uniformity, namely off-types and standard deviations. Details on some of the techniques used in those approaches are provided in TGP/8 "Trial Design and Techniques Used in the Examination of Distinctness, Uniformity and Stability" *[cross ref.]* and cross references are made in the appropriate sections of this document.

SECTION 2: VARIATION IN THE EXPRESSION OF CHARACTERISTICS WITHIN VARIETIES

2.1 Introduction

The observation of variation in the expression of relevant characteristics within varieties is the basis for the assessment of uniformity. This variation has both genetic and environmental components. The level of variation due to the environment depends on the interaction between individual plants and the environment and is influenced by the type of expression of the characteristic. The genetic component is mainly influenced by the features of propagation.

2.2 Type of expression of the characteristic

For quantitative and pseudo-qualitative characteristics, the level of variation due to the environment can differ from species to species and from characteristic to characteristic. There is usually little environmental variation for qualitative characteristics.

2.3 Features of propagation of the variety

2.3.1 With regard to genetic variation and the particular features of propagation of a variety:

(a) a low level of genetic 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 genetic 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 genetic and environmental components. In relation to self-pollinated, vegetatively propagated and mainly self-pollinated varieties a higher genetic variation is accepted. The overall level of variation is, therefore, generally higher in cross-pollinated and synthetic varieties;

(d) genetic variation in hybrid varieties depends on the type of hybrid (single- or multiple-cross), the level of genetic 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 genetic and environmental influences on the variation in the expression of characteristics.

2.3.2 As noted in Section 1 *[cross ref.]*, 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, …". Thus, the General Introduction (see Chapter 6: Section 6.4), explains "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".

2.3.3 The assessment of uniformity by the off-type approach and by consideration of the overall range of variation ("standard deviations approach") is set out in Sections 4 and 5, respectively.

2.4 Segregating characteristics

2.4.1 The General Introduction (Chapter 6: Section 6.4.3.4.1) explains that "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 […]". In addition, for synthetic varieties, a segregation of certain characteristics is acceptable if it is compatible with the method of propagation of the variety.

2.4.2 Thus, for multiple-cross hybrids and synthetic varieties, a segregation for certain characteristics, in particular for 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.

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

2.4.4 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 standard deviations.

2.5 Summary

2.5.1 The type of variation in the expression of a characteristic within a variety determines how that characteristic is used to determine uniformity in the crop. In cases where it is possible to "visualize" off-types, the off-type approach is recommended for the assessment of uniformity. In other cases, the standard deviations approach is used. Thus, the uniformity of a variety may be determined by off-types alone, by standard deviations alone, or by off-types for some characteristics and by standard deviations for other characteristics.

2.5.2 The following table summarizes the common 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	Off-types	Off-types	Off-types
Self-pollinated	Off-types	Off-types	Off-types
Cross-pollinated	Off-types	Off-types	Standard Deviations
Single-cross hybrid (in-bred parent lines)	Off-types	Off-types	Off-types
Other hybrids	*	*	*

* to be considered according to the type of hybrid

SECTION 3: METHOD OF OBSERVATION OF CHARACTERISTICS

3.1 Off-type approach

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 may be 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 in Section 4.2 *[cross ref.]*.

3.2 Standard deviations approach

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.

3.2.2 In the case of the standard deviations approach, the choice of visual observation or measurements for quantitative characteristics, may take into account the following factors:

(a) visual observations are generally quicker and cheaper than measurements but, because they are based on the expert's judgement, they have a particularly important requirement for training and experience to ensure that observations by a DUS examiner for a characteristic are consistent and that repeatability between observers can be achieved; visual observations are appropriate if the data fulfill the conditions for calculation of mean and standard deviation:

(b) measurements may be required in order to provide the appropriate precision for the assessment of variation

SECTION 4: UNIFORMITY ASSESSMENT ON THE BASIS OF OFF-TYPES

4.1 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. In general, off-types are observed visually, although this section also considers the possibility of off-types being determined on the basis of measurements.

4.2 Determination of Off-types

4.2.1 Determination of Off-Types by Visual Assessment

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

> *"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)."

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

4.2.2 Determination of Off-Types Using Measurements

The General Introduction states the following:

> "*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"."

Section to be developed?

4.3 Acceptable number of off-types

4.3.1 Self-Pollinated and Vegetatively Propagated Varieties

4.3.1.1 The General Introduction (Chapter 6: Section 6.4.1.3) explains that "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".

4.3.1.2 As explained in Section 2 *[cross ref.]*, the off-type approach is the common method of assessing uniformity in self-pollinated and vegetatively propagated varieties. However, the General Introduction (Chapter 6: Section 6.4.1.3.2) explains that "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 […]."

4.3.1.3 The Test Guidelines recommend for a particular type(s) of variety a general, i.e. "fixed", population standard and acceptance probability and provide the acceptable number of off-types for a given sample size. The population standard and acceptance probability are fixed on the basis of experience, in particular with reference to other Test Guidelines for comparable types of variety.

4.3.1.4 In the absence of Test Guidelines, an appropriate population standard is fixed on the basis of experience, in particular with reference to Test Guidelines for comparable types of variety.

4.3.1.5 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.]*.

4.3.2 Cross-pollinated Varieties

4.3.2.1 In some cases of cross-pollinated varieties, in particular for qualitative and pseudo-qualitative characteristics, the great majority of individuals of a variety may have the same expression, such that plants with a clearly different expression can be detected as off-types (e.g. "Root: color …" in fodder beet, "Root: color" in fodder radish). In such cases the off-type procedure is appropriate. The number of off-types of a candidate variety should not significantly exceed the number found in comparable varieties already known. Thus, the population standard should reflect the number of off-types found in comparable varieties.

SECTION 5: UNIFORMITY ASSESSMENT ON THE BASIS OF STANDARD DEVIATIONS

5.1 Introduction

The General Introduction (see Chapter 6: Section 6.4) explains that, in cases where there is a wide range of variation in the expressions of characteristics for the plants within a variety, it is not possible to visualize which plants should be considered as off-types and the off-type approach for the assessment of uniformity is not appropriate. It clarifies that in such cases, 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. In this approach, relative tolerance limits for the range of variation are set by comparison with comparable varieties, or types, already known ("standard deviations approach"). The standard deviations approach means that a candidate variety should not be significantly less uniform than the comparable varieties.

5.2 Determining the acceptable level of variation

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

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

5.2.1.3 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]

5.3 Setting standards for new types and species

(*The General Introduction (Chapter 6: Section 6.4.2) indicates that more details will be provided in TGP/10))*

[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.