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INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS
Geneva

TECHNICAL WORKING PARTY FOR AGRICULTURAL CROPS

Forty-Second Session
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REVISION OF DOCUMENT TGP/8: PART II:
SECTION 10: MINIMUM NUMBER OF COMPARABLE VARIETIES FOR
THE RELATIVE VARIANCE METHOD

Document prepared by the Office of the Union

1.   The purpose of this document is to present a proposal for revision of document TGP/8, Section 10: "Minimum Number of Comparable Varieties for Relative Variance Method".

2.   The following abbreviations are used in this document:

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
TWPs:	Technical Working Parties
TWV:	Technical Working Party for Vegetables

BACKGROUND

3.   The Technical Committee (TC), at its forty-eighth session, held in Geneva from March 26 to 28, 2012, considered the proposal for a revision of Section 10: Uniformity Assessment on the Basis of the Relative Variance Method on the basis of document TC/48/19 Rev. "Revision of document TGP/8: Trial Design and Techniques Used in the Examination of Distinctness, Uniformity and Stability", Annex XIV. The TC noted the comments of the Technical Working Party on Automation and Computer Programs (TWC) with regard to some of the assumptions of the method and noted that further investigations would be done by Australia with respect to those assumptions and the F value used in the calculations (see document TC/48/22 "Report on Conclusions" paragraph 65).

4.   The TC agreed with the workplan for the development of TGP/8 presented in Annex XV to document TC/48/19 Rev. which indicated that Section 10: Uniformity Assessment on the Basis of the Relative Variance Method would be considered by the TWPS in 2012. The TC noted that new drafts of relevant sections would need to be prepared by April 26, 2012, in order that the sections could be included in the draft to be considered by the Technical Working Parties (TWPs) at their sessions in 2012 (see document TC/48/22 "Report on Conclusions" paragraphs 49 and 78).

COMMENTS BY THE TECHNICAL PARTIES IN 2012

5.   At their sessions in 2012, the TWA, TWV, TWC, TWF and TWO considered documents TWA/41/26, TWV/46/26, TWC/30/26, TWF/43/26, TWO/45/26, respectively, and commented as follows:

General	The TWA agreed that Chapter 10.2 "Threshold limits for Relative Variance Method" of the Annex to document TWA/41/26 should be considered by the TWC for incorporation in document TGP/8/1 Section 10. The TWA agreed that the remaining paragraphs were already covered by TGP/8/1 Section 10 (see document TWA/41/34 "Report", paragraph 38).	TWA
	The TWV agreed with the proposal of the TWA that Chapter 10.2 "Threshold limits for Relative Variance Method" of the Annex to document TWV/46/26 should be considered by the TWC for incorporation into document TGP/8/1 Section 10 (see document TWV/46/41 "Report", paragraph 37).	TWV
	The TWC noted the comments made by the TWA and TWV and agreed that Section 10.2 should be incorporated in document TGP/8. It requested the drafter to prepare a new draft after checking whether the remaining sections were already covered under section 10 of the TGP/8 (see document TWC/30/41 "Report", paragraph 36).	TWC

COMMENTS BY THE TECHNICAL COMMITTEE IN 2013

6.   The TC, at its forty-ninth session held in Geneva from March 18 to 20, 2013, considered document TC/49/27. The TC noted the proposed amendments of revision of Section: 10 of document TGP/8, as set out in Annex II of document TC/49/27 (see document TC/49/41 "Report on the Conclusions" paragraphs 60 and 61).

7.   The TC agreed to invite the expert from Australia to prepare a new draft of Section: 10 of document TGP/8 with a recommendation on the minimum number of comparable varieties, for consideration by the TWPs at their sessions in 2013. The Delegation of Australia explained that the minimum number was one (see document TC/49/41 "Report on the Conclusions" paragraph 62).

8.   The Annex to this document contains the text proposed by the drafter (Mr. Nik Hulse, Australia) for replacement of the text of Section 10: "Uniformity Assessment on the Basis of the Relative Variance Method", on basis of the comments by the TWPs at their sessions in 2012 and the TC at its forty-ninth session.

> *9.   The TWA is invited to consider the proposed amendments for revision of Section: 10 of document TGP/8, as set out in the Annex to this document and note the comments made by the TWPs at their sessions in 2012 and the TC at its forty-ninth session.*

[Annex follows]

ANNEX

TGP/8/1: PART II: 10: UNIFORMITY ASSESSMENT ON THE BASIS OF THE RELATIVE VARIANCE
METHOD

Note for Draft version

Underlining (highlighted) indicates proposed changes to document TGP/8/1

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10. UNIFORMITY ASSESSMENT ON THE BASIS OF THE RELATIVE VARIANCE METHOD

10.1 Use of the relative variance method

10.1.1 The relative variance for a particular characteristic refers to the variance of the candidate divided by the average of the variance of the comparable varieties (i.e. Relative variance = variance of the candidate/average variance of the comparable varieties). The data should be normally distributed. The relative variance method may be applied to any measured characteristic that is a continuous variable irrespective of the method of propagation of the variety. Comparable varieties are varieties of the same type within the same or a closely related species that have been previously examined and considered to be sufficiently uniform (see document TGP/10, Section 5.2 "Determining acceptable level of variation").

10.1.2 In cross-pollinated varieties, a common recommendation in the UPOV Test Guidelines is to take 60 measurements per characteristic per variety. In essence, the variance ratio equates to the F statistic, and the tabulated value of F at P = 0.01 under df_1 =60 (degrees of freedom of candidate) and $df_2 = \infty$ (degrees of freedom of comparable variety(ies)) is 1.47, $df_2 = \infty$ is chosen as a conservative estimate, as it is assumed that comparable varieties accurately represent the infinite number of possible comparable varieties for the species as a whole. Therefore, 1.47 is the threshold limit for cross-pollinated species with 60 measurements per characteristic per variety. For different sample sizes, a different F statistic should be used for the df_1, although the df_2 should remain at ∞.

10.2 Threshold limit for different sample sizes

10.2.1 However, when there is a limited number of comparable varieties available for a species, it is not practical to use a conservative estimate of $df2 = \infty$. In those cases, it is recommended to use the actual sample size of the comparable varieties to estimate the value of df2. For example, if the actual sample size of the comparable varieties is 60, and the number of comparable varieties is limited for that species, then the threshold limit is 1.84. (df1 =60, df2 =60).

10.2.2 The minimum number of comparable varieties is in part determined by the total number of comparable varieties available within the relevant taxon. Where the available number of comparable varieties is very low, it is recommended that all are included. In cases where the number of comparable varieties is large, then the number includes those in the trial but may also take into consideration data from previous trials where the authority determines that the comparable varieties in the trial may not provide a representative estimate of the population variance for all comparable varieties.(see TGP/8.1 section 3.6.2.2 for guidance on expansion of variety by year tables). Further information on the use of previous empirical data to estimate variance is included in ASTM E122-09e1 "Standard Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average Characteristic of a Lot or Process".

10.3 The relative variance test in practice

10.3.1 When the calculated relative variance is lower than the tabulated value of F then it is reasonable to assume that the variances are equal and the candidate variety is uniform in that particular characteristic. If the calculated relative variance is higher than the tabulated value of F, then the null hypothesis, that the varieties have equal variances, is rejected. The candidate variety would then be deemed to have a higher variance than the comparable varieties for that particular characteristic and, therefore, would not meet the uniformity criteria.

10.4   Example of relative variance method

Example

10.4.1   In a DUS trial, a cross-pollinated candidate variety is grown together with a number of varieties representing the required level of uniformity for all relevant characteristics.   In order to illustrate the calculation of the relative variance, an example with 4 comparable varieties is given.   The variance data on plant height measurements for the five varieties are presented in Table 1. For each variety, 60 plants were measured for plant height:

10.4.2   The number of observations per variety is the same (n=60); therefore, we can take the average variance of the comparable varieties as their pooled variance.

10.4.3   The average variance for comparable varieties is   (7.8 + 4.5 + 3.2 + 5.8)/4 = 5.32

If the variance of the candidate variety is lower than the average variance of the comparable varieties then no further test is required. It can be deemed that the candidate variety is sufficiently uniform in the relevant characteristic.   However, if the variance of the candidate variety is higher than the average variance of the comparable varieties then the variances need to be compared using the relative variance method.

Table 1: variances of candidate and comparable varieties for plant height data

Candidate	Comparable variety 1	Comparable variety 2	Comparable variety 3	Comparable variety 4
5.6	7.8	4.5	3.2	5.8

10.4.4   The relative variance for a particular characteristic refers to the variance of the candidate divided by the average of the variance of the comparable varieties.

Relative variance = variance of the candidate/average variance of the comparable varieties

= 5.6/5.32 = 1.05

10.4.5   For a sample size of 60, the threshold limit is 1.47; therefore, we can conclude that the candidate variety is sufficiently uniform for that characteristic.

10.4.6   This is a conservative estimate of the relative variance method using df2 = ∞. If the variety is found to be non-uniform using this conservative approach then the competent authority may consider whether additional approaches, such as using the actual sample of the comparable varieties for the estimation of df2, are appropriate to provide a more precise estimate of uniformity.

10.5   Relationship between relative variance and relative standard deviation

10.5.1   Sometimes in DUS trials, the uniformity data is presented in terms of standard deviations, not as variances.   Mathematically there is a simple relationship between variance and standard deviation, as follows:

Standard deviation = square root of Variance

10.5.2   When making a decision on uniformity based on relative standard deviations, the same principle for acceptance or rejection applies for relative standard deviation; only the threshold limits are lower due to the square root of appropriate values.   For example, for 60 samples the relative variance threshold is 1.47; however, for relative standard deviation the threshold is 1.21, which is the square root of 1.47.

10.6   References

ASTM Standard C33, 2003a, "Standard Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average Characteristic of a Lot or Process", ASTM International, West Conshohocken, PA, 2011, DOI: 10.1520/EO122-09EO1, www.astm.org.

[End of Annex and of document]