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INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS
Geneva

TECHNICAL COMMITTEE

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Geneva, March 18 to 20, 2013

REVISION OF DOCUMENT TGP/8: PART II: TECHNIQUES USED IN DUS EXAMINATION,
SECTION 3: THE COMBINED-OVER-YEARS CRITERIA FOR DISTINCTNESS (COYD)

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 3: "The Combined–Over-Years Criteria for Distinctness (COYD)".

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 revision of Section 3: The Combined–Over-Years Criteria for Distinctness (COYD) on the basis of Annex XIII to document TC/48/19 Rev. "Revision of document TGP/8: "Trial Design and Techniques Used in the Examination of Distinctness, Uniformity and Stability", as prepared by an expert from the United Kingdom.

4.   The TC agreed that the reference to COYD and COYU should be checked throughout Section 3 of document TC/48/19 Rev.. The TC also requested data to be provided in support of the proposal to reduce the minimum degrees of freedom for the varieties-by-years mean square in the COYD analysis of variance from 20 to 10. It also agreed that the following wording in Section 3.1 "Summary of requirements for application of method" should be amended because it meant that Long-Term COYD could be used with less than 10 degrees of freedom:

> "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 below);"

(see document TC/48/22 "Report on conclusions" paragraph 64).

5.   The TC agreed with the workplan for the development of document TGP/8 presented in Annex XV to document TC/48/19 Rev., which indicated that a document, presenting a proposal for revision of Section 3: "The Combined–Over-Years Criteria for Distinctness (COYD)" 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 WORKING PARTIES IN 2012

6.   At the their sessions in 2012, the TWA, TWV, TWC, TWF and TWO considered documents TWA/41/23, TWV/46/23, TWC/30/23, TWF/43/23, TWO/45/23, respectively, presenting a proposal for revision of document TGP/8, Section 3: "The Combined-Over-Years Criteria for Distinctness (COYD)", and commented as follows:

General	The TWA noted the proposal for the revision of the minimum number of degrees of freedom for distinctness. The TWA agreed to request the TWC to clarify the changes and to suggest how to revise the schematic in document TGP/8 Part I Section III: Choice of statistical methods for examining for distinctness Chapter 3.4 "Requirements for statistical methods for distinctness assessment" (see document TWA/41/34 "Report", paragraphs 33 and 34).	TWA
	The TWV noted the proposal for the revision of the minimum number of degrees of freedom for distinctness. The TWV agreed with the proposal of the TWA to invite the TWC to clarify the changes and to suggest how to revise the schematic in document TGP/8 Part I Section III: Choice of statistical methods for examining for distinctness Chapter 3.4 "Requirements for statistical methods for distinctness assessment" (see document TWV/46/41 "Report", paragraph 34).	TWV
	The TWC clarified that the proposal to reduce the minimum degrees of freedom provided suitable statistical methods for smaller trials, even though 20 degrees of freedom was preferable (see document TWC/30/41 "Report", paragraph 28).	TWC
TGP/8/1, Part I: 3 Schematic 3.4 on page 39	The TWC also clarified that Schematic 3.4 on page 39 of document TGP/8/1, Part I: 3 concerned analysis and not test design and therefore it did not need to be changed. The TWC considered that this Schematic was consistent with the proposed changes in degrees of freedom (see document TWC/30/41 "Report", paragraph 29).	TWC

7.   The TC-EDC, at its meeting on January 9 and 10, 2013, considered document TC-EDC/Jan13/11 "Revision of document TGP/8: Part II: Techniques Used in DUS Examination, Section 3: "The Combined-Over-Years Criteria for Distinctness (COYD)".The TC-EDC made no proposals concerning the text provided in the Annex to this document.

8.   The Annex to this document contains the text considered by the TWPs at their sessions in 2012. The amendments to the text presented in document TC/48/19 Rev., Annex XIII, considered by the TC, at its forty-eighth session, are indicated by highlighting and strikethrough for deletions and highlighting and underlining for additions.

> *9.   The TC is invited to consider the Annex to this document, as a basis for a future revision of document TGP/8: Part II: Techniques Used in DUS Examination, Section 3: "The Combined–Over-Years Criteria for Distinctness (COYD)".*

[Annex follows]

DOCUMENT TGP/8

PART II: SECTION 3: THE COMBINED OVER-YEARS CRITERIA FOR DISTINCTNESS (COYD)

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., or 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);

[…]

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., or iIf 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. . 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. The fewer the degrees of freedom for the residual mean square below 20, the greater the loss in precision in the estimate of the varieties-by-years variation used in the LSD. This is compensated for by the critical t-value, t_p, used in the LSD being larger, which results in a reduction in the power of the test: meaning that there is a reduced chance of declaring varieties as being distinct. 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.
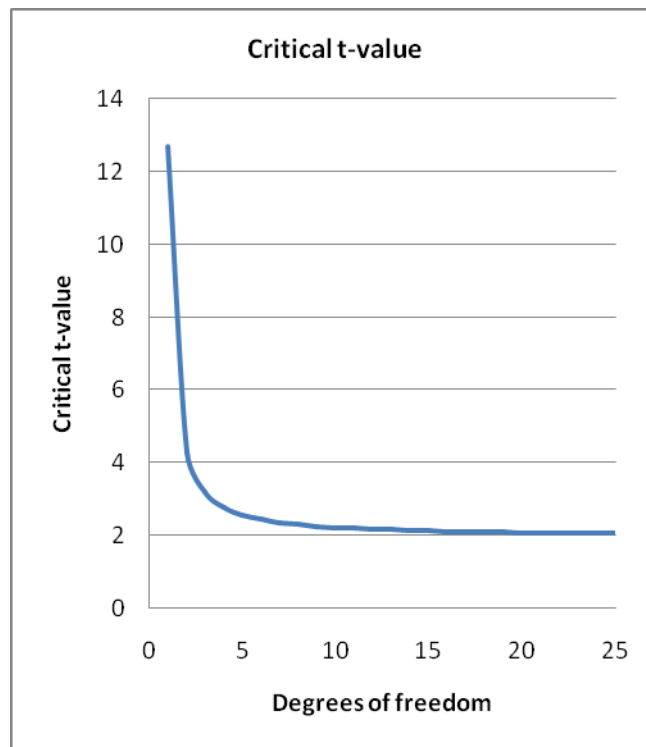
Critical t-value

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.

[…]

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 analyzed 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.

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

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.

                                        [End of Annex and of document]