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INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS

Geneva

TECHNICAL COMMITTEE

Fiftieth Session
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REVISION OF DOCUMENT TGP/8: PART II: SELECTED TECHNIQUES USED IN DUS EXAMINATION, NEW SECTION: STATISTICAL METHODS FOR VISUALLY OBSERVED CHARACTERISTICS

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1. The purpose of this document is to report on developments concerning a possible New Section: "Statistical Methods for Visually Observed Characteristics" to be introduced in document TGP/8: Part II: Techniques Used in DUS Examination, in a future revision of document TGP/8.

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 TC, at its forty-eighth session, held in Geneva from March 26 to 28, 2012, considered the proposal for a New Section: "Statistical methods for visually observed characteristics" to be introduced in document TGP/8: Part II: Techniques Used in DUS Examination 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 X, as prepared by an expert from Denmark. The TC agreed that the section "Statistical methods for visually observed characteristics" should be redrafted with assistance from DUS experts in Denmark in order to focus on guidance for DUS examiners and should replace detailed statistical models with a general reference to suitable statistical methods. The TC agreed that the examples based on Sugar Beet should be replaced by a crop for which there are Test Guidelines and that the example for Wheat should be replaced by a realistic example, such as could be found in Hemp or Spinach. The TC also agreed that the TWC should explore the consequences of the decisions for DUS examination, because the method is a test for differences in the distribution (both location and dispersion). It also agreed that the consequences of excluding certain varieties from the test, where there were insufficient numbers in some cells, should be further investigated (see document TC/48/22 "Report on the conclusions", paragraph 61).

4. The TC, at its forty-ninth session, held in Geneva, from March 18 to 20, 2013, considered document TC/49/32.

5. Annex II to document TC/49/32 contained proposed text by the drafter (Mr. Kristian Kristensen, Denmark) for New Section: "Statistical methods for visually observed characteristics", on the basis of comments by the TWPs, at their sessions in 2012. The amendments to the text considered by the TWPs at their sessions in 2012 were indicated by highlighting and strikethrough for deletions and highlighting and underlining for additions.

6. Annex III to document TC/49/32 contained a copy of supplementary information concerning consequences of the decisions for DUS examination as background information for consideration when document TWC/30/29 was discussed by the TWC, at its thirtieth session, held in Chisinau, Republic of Moldova, from June 26 to 29, 2012 (see document TWC/30/19 "Consequences of Decisions for Examination of Distinctness, Uniformity and Stability").

7. The TC, at its forty-ninth session, agreed that it would not be appropriate to continue the development of a section on "Statistical Methods for Visually Observed Characteristics", unless new guidance was provided beyond the methods already provided in document TGP/8. In that regard, it requested the TWC to clarify if it proposed to modify an existing method or provide a new additional method (see document TC/49/41 "Report on the conclusions", paragraph 72).

COMMENTS BY THE TECHNICAL WORKING PARTIES IN 2013

8. At their sessions in 2013, the TWO, TWF, TWV, TWC and TWA considered documents TWO/46/23, TWF/44/23, TWV/47/23, TWC/31/23 Rev. and TWA/42/23 Rev., respectively.

9. The TWC agreed that the method proposed in Annex II to document TC/49/32 was new and considered that it had advantages over the Chi-square test already provided in document TGP/8 for multinomial distributed data, such as visually observed characteristics, whereas COYD for normally distributed data is not suitable for multinomial distributed data (see document TWC/31/32 "Report", paragraph 53).

10. The TWC agreed that it would be beneficial to further develop the method for multinomial data and to compare the decisions made using the two methods – the COYD method for normally distributed data and the Chi-square test – based on real data from Finland and the United Kingdom (Timothy, Red Clover and Meadow Fescue: growth habit). The TWC also noted that Finland planned to use the new method for multinomial data, once it had been established and potentially also the United Kingdom (see document TWC/31/32 "Report", paragraphs 54 and 55).

11. The TWA noted the memorandum presented in Annex I to document TWA/42/23 and the comments by the TWC which clarified that the method proposed to the TC, at its forty-ninth session, to deal with multinomial distributed data was a new method (see document TWA/42/31 "Report", paragraph 60).

12. The TWA agreed with the TWC that it would be beneficial to further develop the method for multinomial data and to compare the decisions made using the two methods based on real data from Finland and the United Kingdom (see document TWA/42/31 "Report", paragraph 61).

13. The experts from the Netherlands and Germany expressed their intention to use the new method for multinomial data, once it had been established (see document TWA/42/31 "Report", paragraph 62).

14. Following the retirement of Mr. Kristian Kristensen (Denmark), drafter of the proposed new section, the TWC will seek to identify a suitable expert to continue the development of the section.

15. The TC is invited to:

(a) agree to the development of a new method for multinomial distributed data;

(b) invite the TWC to compare the COYD method for normally distributed data and the Chi-square test, as set out in paragraph 10 of this document; and

(b) request the TWC to identify a suitable expert to act as a drafter.

[Annex follows]

ANNEX

MEMORANDUM FROM THE EXPERT OF DENMARK

Background

The COYD method for normally distributed data was introduced in UPOV many years ago in order to ensure that the decisions taken would be more consistent over future years than those obtained from the conventional 2x1% method. Recently, further work has been done to develop a COYD method for multinomial distributed data such as visually observed characteristics.

This memorandum provides analysis on similarities and differences between the method which was proposed to the TC, at its forty-ninth session, to deal with multinomial distributed data, and two existing methods already provided in document TGP/8 which are related to the proposed method (the COYD method for normally distributed data and the χ^2-test).

Analysis on Similarities and Differences

Similarities between the COYD for normal distributed data and the proposed COYD method for multinomial distributed data

- They both aim at ensuring that the decisions taken will be consistent over future years.

- They both do this by calculating a measure of the interaction between years and varieties and then take this into account when comparing the varieties.

Differences between the COYD for normal distributed data and the proposed COYD method for multinomial distributed data

- The result for a given variety in a given year can be characterized by a single mean for normally distributed data whereas several values (counts or percentages) needs to be used for multinomial distributed data: for example, 5 counts or percentages are needed in order to characterize a variety if the note can take 5 discrete values (strictly speaking only 4 percentages is really needed as the sum of the 5 percentages should sum to 100).

- For normally distributed data the variability caused by random sampling is usually considered to be independent on the means and thus to be the same for all varieties. This assumption can't be applied for multinomial distributed data as here the random variation caused by sampling is known to depend on the mean value (count or percentage) of the actual note.

- For normally distributed data the variability caused by interaction between years and varieties can be characterized by a single value for each combination of year and variety. This is usually also the case for binomially distributed data and multinomial distributed characteristics if they are recorded on an ordinal scale. However for multinomial distributed data recorded on the nominal scale, more values are needed to characterize the interaction between years and varieties: for example, if there are 5 different notes 4 times the number of combinations of years and varieties are needed.

- For normally distributed data the varieties can be compared using t-tests (or F-tests with one degree of freedom in the numerator). This is usually also the case for binomially distributed data and multinomial distributed characteristics if they are recorded on an ordinal scale. However for multinomial distributed data recorded on the nominal scale an F-test is needed and this F-test will have more than one degree of freedom in the numerator: for example, if there are 5 notes there will be 4 degrees of freedom in the numerator of the F-tests used for comparing two varieties.

- The COYD method for multinomial distributed data requires more computer power that the COYD method for normally distributed data, but with the computer power available today this should not be a serious problem.

Differences between the χ^2-test and the proposed COYD method for multinomial distributed data

- The χ^2-test does only take the variability caused by random sampling into account when used to compare varieties on characteristics that are multinomial distributed. This can be considered to be similar to comparing the variety means of normally distributed characteristics using an analysis were the variability between plants within each plot is used when calculating a t-test for comparing two varieties. This would be expected to give too many significant results as the variability caused by soil variation and other growing conditions are ignored. Similarly the χ^2-test is expected to give too many significant t-tests if the note depends on the soil variation and/or other growing conditions.

- The χ^2-test does not depend on the scale of measurements, so data recorded on the nominal scale and ordinal scale are treated the same way and because the χ^2-test ignores the ordering of notes on the ordinal scale. The proposed new method for characteristics recorded on the ordinal scale takes this ordering into account. The proposed method is therefore expected to be more effective if the data are recorded on the ordinal scale than if they are recorded on the nominal scale.

Consideration

For multinomial distributed data, the most common method is the χ^2-test for independence in a contingency table. However, this method does only take the variation caused by random sampling into account. This means that the decisions for characteristics that depend on the growing conditions such as soil fertility and climate will be too liberal and thus not necessarily consistent over future years.

The COYD method for normally distributed data can't be used for multinomial distributed data. Therefore it is considered that a new method that better ensures that the decisions taken are consistent over future years should be developed. The work has been performed under the heading of "Statistical methods for visually observed characteristics" with sub-titles: "The combined over-years method for ordinal characteristics", "The combined over-years method for nominal characteristics" and "The combined over-years method for binomial characteristics", which could be combined under the title: "The combined over-years method for multinomial characteristics".

It is considered that it is very important to develop a method for visually observed characteristics that performs better than the χ^2-test regarding consistent conclusions over future years.

[End of Annex and of document]