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UPOV

TWF/XX/9
ORIGINAL: English
DATE: December 1, 1989

INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS

GENEVA

TECHNICAL WORKING PARTY FOR FRUIT CROPS

Twentieth Session

Wageningen, Netherlands, September 26 to 29, 1989

REPORT

adopted by the Technical Working Party for Fruit Crops

Opening of the Session

1. The twentieth session of the Technical Working Party for Fruit Crops (hereinafter referred to as "the Working Party") was held in Wageningen, The Netherlands, from September 26 to 29, 1989. The list of participants is given in the annex to this report.

2. Mr. C.A.A.A. Maenhout, Deputy Director of RIVRO, welcomed the participants to his office in Wageningen.

Election of an Ad hoc Chairman

3. The Working Party noted that Mr. Bar-Tel (IL) was unable to atttend the session and that he had proposed to elect Mrs. E. Buitendag (ZA) as ad hoc Chairman for the session. Having noted further the willingness of Mrs. Buitendag to accept that task and in the absence of any further proposal, the Working Party unanimously elected Mrs. Buitendag as ad hoc Chairman of the session.

Adoption of the Agenda

4. The Working Party unanimously adopted the agenda for its twentieth session as reproduced in document TWF/XX/1.

Short Reports on New Developments in the Member States in Plant Variety Protection in Fruit Species

5. The Working Party received short reports from some of the experts on recent developments in their countries. It noted with special interest the possibilities of patenting plants and plant varieties in Switzerland, the discussions on the abolition of the farmer's privilege in several countries, the problems connected with mutations in apples, problems with plant material infected by virus, the identification of rootstocks of interspecific hybrids. It also noted that in future it might be necessary to change from the description of the phenotype of a variety to that of its genotype.

Important Decisions Taken During the Last Sessions of the Technical Working Party and of the Technical Committee

6. Dr. M.-H. Thiele-Wittig gave a brief report on the main items discussed during the last session of the Technical Committee, referring for further details to the full report reproduced in document TC/XXIV/6.

Final Discussion on Draft Test Guidelines

Test Guidelines for Banana

7. The Working Party noted that, with the exception of a letter from an expert from Honduras (Mr. R.H. Stover), no comments in writing had been received regarding the draft Test Guidelines for Banana as reproduced in document TG/123/1(proj.). It therefore only made the following main changes in the document:

(i) Methods and Observations: In paragraph 3 the words "and standardized" should be deleted, in the first sentence of paragraph 7 the words "and the fruit" should be deleted and the second sentence of paragraph 7 should read: "All observations on the fruit should be made on the ripe fruit at the optimum edible stage." The whole bracketed contents of paragraph 7 should be deleted.

(ii) Table of Characteristics:

Characteristic

1 to have the spelling of "Grand Nain" corrected here and throughout the document

2 to have the example varieties "Lancefield (5), Poyo (7)"

6 to read: "Leaf blade: shape of apex"

10 to have the example varieties "Poyo (3), Valery (5), Grand Nain (7)"

12 to have the states "weak, medium, strong"

13 to have the states "clearly ovate (1), intermediate (2), clearly obovate (3)

15 to have the example varieties "Dwarf Cavendish (5), Americani (7)"

18, 19 to have an intermediate state introduced in a similar way as for characteristic 13, with the addition of the word "clearly" for the present states

26 to 30 to have the word "Mature" replaced by "Ripe"

26 to have the additional example variety "Dwarf Cavendish (5)"

27 to have the example varieties "Dwarf Cavendish (3), Poyo (5)"

30 after this characteristic a new characteristic to be inserted, reading "Ripe fruit: length of stalk" with the states "short, medium (Dwarf Cavendish), long (Grand Nain)"

(iii) Literature: To have the additional literature "Stover, R.H.; 1988: Variation and cultivar nomenclature in Musa, AAA Group, Cavendish subgroup" Fruits d'Outre-mer, Vol. 43, No. 6, pp 353-357, FR"

(iv) Comments From the Expert From Honduras: The Working Party explained that it restricted the Test Guidelines to the AAA Group, as the commercial varieties came all from that group. If, in future, varieties of other groups were to be commercialized, the document would be revised. It agreed that growing conditions differed from country to country but comparisons were always made under the same ecological conditions. During the establishing of the Test Guidelines, the Working Party had considered all characteristics in the existing descriptors.

Test Guidelines for Chestnut

8. The Working Party noted that no comments in writing had been received regarding the draft Test Guidelines for Chestnut as reproduced in document TG/124/1(proj.). It therefore only made the following main changes in the document:

(i) Subject of These Test Guidelines: To have the words "its hybrids" replaced by "any other variety of hybrids of Castanea sativa Mill. with any other species of Castanea."

(ii) Table of Characteristics:

Characteristic

9 to have the reference to the drawings and the drawings themselves deleted

15, 16, 23 to have the state "intermediate" included between the present states and to have the word "clearly" added in front of each of the present states, the states to have the Notes "1, 2, 3"

21 to have the Notes "1, 2, 3" and to receive drawings as already indicated in document TWF/XIX/3

(iii) Explanations on the Table of Characteristics: New drawings should be prepared for "Ad 32 and 33" and the words "and star" should be deleted.

Test Guidelines for Walnut

9. The Working Party noted that to the draft Test Guidelines for Walnut as reproduced in document TG/125/1(proj.) comments had been received from experts from France and Spain. These comments were reproduced in document TWF/XX/3. The Working Party finally made the following main changes in document TG/125/1(proj.):

(i) Table of Characteristics:

Characteristic

1 to have the word "below" replaced by "between grafting point and"

2 to have the states "erect (3), semi-erect (5), spreading (7)"

3 to have the characteristics 30, 31, 32, 33 included after this characteristic

4 to read: "Tree: female inflorescence" with the states "single (1), compound (2)"

5 to receive the explanations "indeterminate (female flowers on lateral spurs), determinate (female flowers at end of branches)"

8 to be placed after characteristic 35 and to read: "Leaf: persistance of rachis" with the states "not persistant (Franquette, Hartley, Marbot, Payne (1)), persistant (Grandjean (9))"

9 to have characteristic 34 included after this characteristic

15, 16 to have the last state deleted and to have the Notes "1, 2, 3, 4"

15 the expression "truncate" to read "flat"

18 to have the Notes "1, 2, 3"

22 to have the words "depth of" included before "groove"

27 to read: "Kernel: intensity of ground color"

31 to have the example variety "Chico" deleted

33 to have the additional example variety "Amigo (3)"

34 to receive an asterisk and to have the example variety "Chico" deleted

37, 38 to be deleted

(ii) Letter From Spain: The Working Party kept its definition of maturity as it was easier to fix. It agreed to the last proposal with respect to the variety Chico. It deleted characteristics on resistance in the absence of standardized methods. It could not yet agree on the inclusion of characteristics on the isoenzymatic phenotype.

Test Guidelines for Black Currant (Revision)

10. The Working Party noted that no comments in writing had been received regarding the draft Test Guidelines for Black Currant as reproduced in document TG/40/4(proj.). It therefore only made the following main changes in the document:

(i) Subject of These Test Guidelines: The name of the family "Saxifragaceae" should be added. The Working Party confirmed that the name of the family was considered to be useful information in all Test Guidelines.

(ii) Methods and Observations: To receive an additional paragraph 9 reading: "The description of the variety should be supplemented by a shadowgraph of four typical leaves."

(iii) Table of Characteristics:

Characteristic

1 to be split into two characteristics: "Plant: height" with the states "short (Strata), medium, tall (Titania)" and "Plant: diameter" with the states "small (Brödtorp), medium, large (Blacksmith)"

2 to read: "Plant: ratio height/diameter" with the states "low (Brödtorp (3)), medium (Baldwin Hilltop (5)), high (Westra (7))"

3 to have the example variety "Daniels September" replaced by "Blacksmith"

9 to have the words "shape of" added before "base"

11 to have the additional state "at distal part only (3)"

16 to have the states "flat round (3), round (5), long round (7)"

20 to be deleted

(iv) Explanations on the Table of Characteristics: The drawing for characteristic 16 should be deleted. Before the drawings for characteristic 21 the words "Explanation on time of observation" should be included.

(v) Literature: The following literature should be added: "Todd, J.C., 1962: "Black Currant Varieties, Their Classification and Identification", Ministry of Agriculture, Fisheries and Food, Technical Bulletin No. 11, London, GB"

States of Expression in Test Guidelines

11. The Working Party noted document TC/XXIII/5, document TC/XXIV/3, paragraphs 99 to 107, document TC/XXIV/6, paragraph 61, as well as Annex V of document TC/XXV/3 containing a summary of the positions taken by the different Technical Working Parties. It finally changed its position with regard to the following points. It agreed to the examples 5(i) to 5(v), 8.1 and 16.1 to 16.8. It disagreed with the examples 11.1, 12.6 and 14.3. For example 11.1 it proposed the insertion of a state "intermediate" and the addition of the word "clearly" in front of the existing states.

Minimum Distances Between Varieties

12. The Working Party noted document TC/XXIII/6, Annex V, paragraphs 14 to 45, as well as a short oral report on the results of the different workshops held on minimum distances in the testing of lettuce and elatior begonia and pelargonium, as well as on new technology in the testing of varieties as reproduced in document TC/XXV/7. It noted the wish of certain breeders for larger minimum distances between the varieties and the use of more performance characteristics. It agreed that discussions with breeders on the correct distances were necessary. The use of performance characteristics was more expensive and performance characteristics reacted often more to environmental changes. Thus, in the presence of sufficient other existing characteristics, they should be avoided. Care should also be taken not to broaden the minimum distances too much, thereby creating new umbrella varieties.

13. At present a candidate variety was sufficiently distinct from an existing variety if the expert doing the observation could clearly see the difference and define it. This difference should be kept, if possible, also in future once the concept of dependency was introduced. This concept of dependency should be introduced as soon as possible.

Color Observations

14. The Working Party noted a report and explanations from the expert from the Federal Republic of Germany on joint trials with the registration group of the Permanent Judgement Committee (VKC) of the Royal Society for Horticulture and Plant Science (KMTP) of The Netherlands, on the use of a chromameter for the measuring of colors. While the method allowed to detect very small differences, it was not, however, the aim to reduce the differences. At present that method was only intended to support decisions taken on the basis of the RHS Colour Chart and to make them more objective. Its support was especially appreciated in cases where applications had to be rejected.

New Methods, Techniques and Equipment in the Examination of Varieties

15. The Working Party noted document TC/XXIV/6, paragraphs 20 to 32 and 35 to 39, containing the results of the discussions on that subject during the last session of the Technical Committee, as well as document TC/XXV/4 containing information received by the Office of the Union as a result of the discussions held by the Technical Committee and in response to circulars issued pursuant to those discussions.

16. The Working Party had an exchange of views on the possibilities for new technology in the fruit species area. According to the experience of the experts, electrophoresis may be very useful for the identification of plant material in the trade. There was, however, little need for its use in the testing of distinctness in the fruit sector, as sufficient other characteristics were available.

17. The Working Party nevertheless agreed to make an inventory of the species for which electrophoresis was used or under study and of the methods applied in those cases, as well as of the plans of the various member States for the near future. The expert from Italy would collect the information and prepare a summary before the next session of the Working Party. Furthermore, a small subgroup of experts from France, Italy and Spain would study the use of electrophoresis in more detail for peach varieties.

18. The Working Party noted that some countries were studying the possible use of image analysis in variety testing. It would await the results of these studies on non-fruit species before continuing discussions on this method. The expert from South Africa agreed, however, to prepare a short report on her results with image analysis applied to mango. In addition, in the Federal Republic of Germany, the possibilities of recording characteristics of plants by image analysis was being studied.

Statistical Methods

19. The Working Party received very detailed explanations on the aplication of statistical methods from Mr. Baltjes (NL) with clear explanatory examples. The summary of those explanations are reproduced in Annex II to this document. He also reported on the history of the various methods applied to measured characteristics leading finally to the COY analysis. The Working Party agreed with him that non-parametric statistical methods could and should be applied more often. It also agreed that results from measured characteristics should always be presented with statistical support.

Revision of the UPOV Model for a Report on Technical Examination

20. The Working Party noted documents TC/XXIV/4, TC/XXIV/6, paragraphs 72 to 74, and document TC/XXV/6, as well as a photocopy of Annex III of document TC/XXV/3 containing a summary of the positions of the other Technical Working Parties with respect to the proposals made in document TC/XXV/6. It finally made the following remarks:

(i) General Remarks

The Working Party agreed to the proposals (iii) to (viii), but it disagreed with the proposals (i) and (ii). With respect to the proposal (iii), it stated that the first group of eight items before the heading and the second group of eight items immediately after the heading of Annex I of document TC/XXV/6 should, after having been amended, be repeated in its entirety without any further changes in the beginning of the Variety Description Form, as well as in the other two forms.

(ii) Report on Technical Examination

The Working Party agreed to the comments 1; 5(i); 6; 8(i); 9, 10(i); and 9, 10(iv). It disagreed with the comments 5(ii); 7; 8(ii). It proposed that the first four items have the order changed to 1, 3, 4, 2.

(iii) Interim Report on the Examination of a Variety

The Working Party had no further comments to this form besides the proposal to copy the first 16 lines of the Report on Technical Examination.

(iv) Request for Examination Results

The Working Party agreed to copy the first 16 lines of the Report on Technical Examination in its entirety. It further agreed to the proposals 9(ii) and 10, and to the proposal of the TWO to add an additional sentence on fees. It disagreed with the comments 9 (i); 9(iii) and 11.

21. The Working Party noted that Section C of the Variety Description Form, which also appears in all Technical Questionnaires, was often completed in a way that left doubts as to whether the remarks referred to the candidate variety or to the similar variety. The Working Party therefore proposed to amend Section C to read:

"C. Similar Varieties and Differences in Relation to Those Varieties:

Denomination of similar variety	Characteristic in which the similar variety is different	State of expression of similar variety	State of expression of candidate variety "

Cooperation With Breeders in the Testing of Varieties

22. The Working Party noted document TC/XXIV/6, paragraph 65, and document TC/XXV/5, as well as a copy of Annex II of document TC/XXV/3 giving an updated version of the first page of the annex of document TC/XXV/5. It further noted that also in South Africa tests are exclusively done by the national authorities. Having discussed the different possibilities to involve the breeder in the growing tests, the Working Party agreed that there should be more exchange of information with the breeders, however, the description of the varieties should always be made by the authorities. For certain minor crops the breeder could grow the plants and the authorities could make the observations on the premises of the breeder.

General Framework for Test Guidelines for Wild Fruiting Species

23. The Working Party noted document TWF/XX/2, prepared by experts from the Federal Republic of Germany. It had a discussion on the principle of establishing Test Guidelines for a group of species and finally decided that this was too difficult. Test Guidelines would have to be established for each genus or species separately. The experts from the Federal Republic of Germany would prepare for the next session a working paper on Test Guidelines for Chokeberry (Aronia melanocarpa L.)

Discussion of Working Papers on Test Guidelines

Test Guidelines for Blueberry

24. The Working Party noted document TWF/XX/6 containing a Table of Characteristics for Test Guidelines for Blueberry. It made the following main changes in the document:

(i) Table of Characteristics:

Characteristic

1 to have the same wording as characteristic 5 of the document on Red and White Currant

2, 8, 9, 10 to be deleted

3 to have the word "mature" replaced by "fully developed"; after this characteristic two new characteristics to be inserted reading: "Flower: shape" and "Flower: color of petal"; the states will have to be decided on by the experts from the Federal Republic of Germany

6 to receive explanatory drawings

11 to be checked, the experts from the Federal Republic of Germany to bring pictures to the next session

12 the words "base of petiole" to be replaced by "stalk attachment"

13 to read: "Time of bud burst"

14 to read: "Time of beginning of flowering"

15 to read: "Time of fruit ripening"

(ii) The experts from the Federal Republic of Germany would prepare, before the end of February 1990, a new draft containing also the other information not covered by the Table of Characteristics.

Test Guidelines for Jostaberry

25. The Working Party noted document TWF/XIX/5 containing a working paper on Test Guidelines for Jostaberry, as well as document TWF/XX/8 containing an updated Table of Characteristics with the indication of example varieties. It finally made the following main changes in document TWF/XX/8 as far as the Table of Characteristics was concerned, and in document TWF/XIX/5 as far as the rest of the Test Guidelines were concerned:

(i) Subject of These Test Guidelines: To have the family name "Saxifragaceae" added. The experts from the Federal Republic of Germany to check the author of the Latin name.

(ii) Grouping of Varieties: To have the first grouping characteristic deleted.

(iii) Table of Characteristics:

Characteristic

2 before this characteristic two new characteristics to be inserted, the first to read: "Plant: height" with the states "low, medium, high" and the second to read: "Plant: width" with the states "narrow, medium, broad"

8 to have the states "few to medium (Josta (4)), medium (5), medium to many (Jogrande (6)) and to be still checked by the experts from the Federal Republic of Germany

9 to have the Notes "3, 5, 7"

13 to have the word "fruit" inserted before "maturity"

(iv) Technical Questionnaire: To have characteristic 9 deleted from item 5.

Test Guidelines for Lingonberry

26. The Working Party noted document TWF/XX/7 containing a Table of Characteristics for Test Guidelines for Lingonberry. It made the following main changes in that document:

(i) Table of Characteristics:

Characteristic

2 to read: "Leaf: intensity of green color"

3 to be placed before characteristic 2

4 to read: "Leaf: ratio length/width" with the states "small, medium, large"; before this characteristic two new characteristics to be inserted, the first to read: "Leaf: length" with the states "short, medium, long" and the second to read: "Leaf: width" with the states "narrow, medium, broad"

5 to read: "Fruit: intensity of red color" with the states "light, medium, dark"

6 to have the states with the Notes "3, 5, 7"

7 to have the states "globose (1), globose to ellipsoid (2), ellipsoid (3), ellipsoid to ovoid (4), ovoid (5)"

9 to read: "Time of beginning of first flowering"

10 to read: "Time of beginning of second flowering"

11 to read: "Time of beginning of fruit ripening from first flowering"

12 to read: "Time of beginning of fruit ripening from second flowering"

(ii) The experts from the Federal Republic of Germany would prepare, before the end of February 1990, a new draft containing also the other information not covered by the Table of Characteristics.

Test Guidelines for Red and White Currant (Revision)

27. The Working Party noted document TWF/XIX/9, as well as document TWF/XX/5 prepared by the Office of the Union on the basis of document TWF/XIX/9. It finally made the following main changes in document TWF/XX/5:

(i) Subject of These Test Guidelines: To have the family name "Saxifragaceae" added.

(ii) Methods and Observations: Paragraph 2 to read: "All observations should be made on 10 parts of 4 plants." After paragraph 9 a new paragraph 10 should be added reading: "The description of the variety should be supplemented by a shadowgraph of 4 typical leaves."

(iii) Table of Characteristics:

Characteristic

6, 14 to be deleted

11 to have after this characteristic the characteristics 31 to 35 and 43 inserted

19 to have the word "Mature" replaced by "Fully developed"

29 to read: "Fully developed leaf: thickness of petiole"

31 to have the states "few, medium, many"

35 to have the additional state "very strong"; after this characteristic the characteristic 44 to be inserted

40 to have the first state read: "flat-round"

(iv) Literature: No specific literature should be included.

Status of Test Guidelines

28. The Working Party agreed that the draft Test Guidelines for Banana, for Chestnut, for Walnut and for Black currant (Revision) should be sent to the Technical Committee for final adoption.

29. The Working Party agreed that the draft Test Guidelines for Red and White Currant (Revision) should be sent to the professional organizations for comments after the information which is still required has been included.

30. Discussions on working papers on Test Guidelines for Blueberry, for Jostaberry and for Lingonberry will have to be continued during the next session.

31. Lack of time did not allow the Working Party to discuss the working papers on further species mentioned under Item 14 of the Draft Agenda.

Future Program, Date and Place of Next Session

32. The Working Party accepted the invitation from Japan to hold its 1990 session in that country. Having noted that the Technical Working Party for Ornamental Plants and Forest Trees will meet in Japan from September 18 to 24, and having also noted the wish of the Japanese authorities that the Technical Working Party for Fruit Crops meet immediately preceding or following the session of the Technical Working Party for Ornamental Plants and Forest Trees, the Working Party agreed that it would meet from September 10 to 17, 1990. The session would start on September 10 at 9.00 a.m. and would close on September 13 in the evening. The visits to breeders and nurseries would take place from September 14 to 17, partly together with the Technical Working Party for Ornamental Plants and Forest Trees. The expert from Japan would prepare, before the end of the year, a preliminary program indicating possible breeders and nurseries to be visited. During the session, the Working Party plans to discuss the following items:

(a) Short reports on new developments in member States in Plant Variety Protection for fruit species;

(b) Important decisions taken during the last sessions of the Technical Working Party and of the Technical Committee;

(c) Final discussion of draft Test Guidelines for Red and White currant (Revision);

(d) Minimum distances between varieties;

(e) Color observations;

(f) (New) methods, techniques and equipment in the examination of varieties;

(g) Statistical Methods;

(h) Discussion of working papers on Test Guidelines for:

(i) Blueberry (new working paper to be prepared by DE)
(ii) Citrus (Revision) (TG/83/3, TWF/XIX/7)
(iii) Jostaberry (new working paper to be prepared by DE)
(iv) Lingonberry (new working paper to be prepared by DE)
(v) Prunus rootstocks (TWF/XIX/6, TWF/XX/4)
(vi) Apricot (Revision) (working paper to be prepared by FR)
(vii) Pear (Revision) (working paper to be prepared by GB)
(viii) Chokeberry (working paper to be prepared by DE)

Visits

33. On September 27, the Working Party visited the experimental station at Wilhelminadorp, where it was mainly shown tests on apple, but also some trials on black currant, kiwi, hazelnut, walnut and strawberries. In the afternoon of September 28, the Working Party assisted at a demonstration of the state of research on image analysis at the RIVRO.

34. This report has been adopted by correspondence.

[Two annexes follow]

ANNEX I

LIST OF PARTICIPANTS AT THE TWENTIETH SESSION OF THE TECHNICAL WORKING PARTY FOR FRUIT CROPS WAGENINGEN, THE NETHERLANDS, SEPTEMBER 26 TO 29, 1989

I. MEMBER STATES

FRANCE

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[Annex II follows]

ANNEX II

STATISTICAL APPROACHES FOR ESTABLISHING DISTINCTNESS OF VARIETIES

INTRODUCTION

Statistical analysis is generally considered as an important tool in objectively establishing distinctness between varieties.
The actual use of statistical analysis in DUS-testing, however, is restricted to measured characters in some crops. Characters like plant height, fruitwidth, etc. can be analysed, by following an agreed testing procedure, in order to discriminate between varieties.
The types of analyses referred to are called "parametric statistics", which indicates that the data come from a distribution with certain parameters, e.g. the normal distribution.
Scores on characters bases on visual assessment, e.g. leaf color, growth habit, anthocyanin coloration etc. which contribute to a great extend to the appearance of a variety can, however, not be analysed by the same statistical procedures since the conditions for appropriate use of paramatric statistics are not met. In such cases nonparametric statistical analysis can be helpful; nonparametric methods are sometimes called "distribution-free" methods.

The statistical model, power and scale of measurement

Whatever statistical test is applied, it is valid only under certain conditions associated with the model and the measurement requirement.
Parametric statistical tests must fulfill the following conditions which will be treated in greater detail furtheron:

1. The observations must be independant.
2. The observations must be drawn from normally (Gausz) distributed populations.
3. These populations must be homoscedastic (= have equal variances)
4. The variables involved must have been measured in at least an interval scale.

If these conditions hold, which is normally assumed, the choice of a parametric test is optimum because it will be the most powerfull one, that is, it has the largest probability to reject Ho when it is false.
When using a model with less and/or weaker conditions, the conclusion derived by applying the test associated with that model are more general but the test itself is less powerfull. The power of a test can be increased by increasing the sample size. Hence, if we do not meet some of the conditions mentioned above, we can choose another statistical test with less requirements in its model and retain power by increasing the sample size.
The lower power efficiency, the greater the risk that a real difference will not be detected at given sample size. On the other hand, when a low power statistical test is applied which leads to rejection of Ho, this conclusion would certainly have been obtained when a more powerful test could have been applied.

The first of the conditions mentioned above underlies both parametric- and non-parametric tests. Conditions 2 and 3 need not to be met for non-parametric techniques; non-parametric methods are sometimes called 'distribution-free' methods. Condition 4 is not shared by all statistical tests; different tests require measurements of different strength.

Measurement is the process of assigning numbers or other symbols to objects or observations. This can be done in different scales:

Nominal scale. Measurements at is weakest level exist when numbers are used to classify an object in a set of mutually exclusive classes. These numbers (or other symbols) constitute a nominal scale. The members of any one class must be equivalent in the character being scaled. Since the numbers which designate the classes on a nominal scale may be intercharged (provided this is done completely and consistently) without altering the essential information, the only kinds of admissable statistics are those which remain unchanged by such a

transformation, such as the mode, frequency counts, etc.

Ordinal scale. When it appears that objects in one category of a scale are not just different from the objects in other categories of that scale, but that there is some relation to them which can be designated by the caret (>) and this relation holds for all pairs of classes so that a complete ranking order of classes is obtained, we have an ordinal scale. As any order-preserving transformation does not change the information contained in an ordinal scale, it does not matter what numbers are given to a pair of classes or to members of those classes, just as long as we give a 'higher' number to the members of the 'higher' class. With ordinal scales, hypothesis can be tested by using a large group of nonparametric statistics, also called 'order- or ranking statistics'. The most appropriate one for describing central tendency of scores in an ordinal scale is the median, since this is not affected by changes of any scores which are above or below it as long as the number of scores above and below remain the same.
With data in an ordinal scale, arithmetic operations (e.g. calculating mean and standard deviation) on the original scores are not allowed since the distances between the observation classes can not be assumed to be equal.

Interval scale. If a scale has all properties of an ordinal scale and if, in addition, the distances between any two numbers on the scale of measurement are of known size and constant, measurement has been achieved in the sense of an interval scale. The interval scale is the first truly quantitative scale. Calculation of mean and standard deviation is admitted. If measurements are in an interval scale and all other conditions are met, parametric statistical tests should be used, because they are the most powerfull tests in this case.

Ratio scale. When a scale does fulfill the requirements of an interval scale and, in addition, has a true zero-point, it is called a ratio scale. Many statistical tests are usable. The choice of the proper statistical test is based on fulfilling the conditions are not met, nonparametric techniques offer a possible solution; when these conditions are met, parametric methods should preferably be used. Sometimes conditions can be met by means of transformation.

NON-PARAMETRIC TESTS. Tabel 1. gives a survey of nonparametric statistical tests discussed in Siegel (1956). For establishing distinctness between varieties, we can restrict ourselves to:
- χ^2 - test
- Median test
- Wilcoxon test for two independant samples
- Sign test
- Wilcoxon matched-pairs signed-rank test.

χ^2-tests for two independant samples.
The χ^2-test may be used to determine the significance of differences between two varieties when the data consist of frequencies in discrete categories. The hypothesis tested is that the two varieties do not differ with respect to the frequency with which individual plants fall in several classes. The procedure for testing is to count the number of times each variety falls in the various classes and 'compare' those outcomes with those which are expected to occur when both varieties are equal in the characteristic under study. The frequencies found are casted in a $r \times c$ contingency table (i.e. r is 2, which is the number of varieties to be compared).
The obtained value of χ^2 is compared with critical values in a table, with (r-1)(c-1) degrees of freedom and required level of significance.
The χ^2 -test is applicable to data in a contingency table only if the expected frequencies are sufficiently large. When this is not the case, classes have to be combined. This, of course, is only allowed if it does not rob the data of their meaning.
The χ^2 -test is only applicable to absolute frequencies and not to relative ones.

0849

The median test. The median test determines whether it is likely that two independant samples have been drawn from populations with the same median. The test may be used whenever the scores of the two samples are in at least an ordinal scale.
At first the combined median for all scores in both samples has to be determined. Then each set of scores is dischotomized into the number of scores above the combined median and the number of scores below the combined median. Very often (in practice mostly) several scores may fall right at the combined median. If this happens one mostly dichotomizes the scores into those which exceed the combined median and those which do not. A χ^2-test is applied on the obtained 2×2 contingency table.

The Wilcoxon test for two independant samples.
The Wilcoxon test for two independant samples, which can be considered to be of potential interest in distinguishing varieties, is one of the most powerful nonparametric tests. The test is used to investigate whether two independant samples, from which observations in at least an ordinal scale are obtained, have been drawn from the same population. Furthermore it is assumed that the scores in the observations represent a distribution with underlying continuity. The procedure is ranking the observations and summing the ranknumbers of the smaller sample. The obtained W-statistic is compared with the critical values in specially constructed tables. These tables have some limitations in that they are restricted to limited sample size. This, however, is no problem as for increasing sample sizes the W-statistic tends to be normally distributed under Ho.
Although the effect is negligable, a correction for 'ties' is available for use with the normal curve approximation. This can only improve the power of the test.

The sign test. The sign test is one of the simplest nonparametric tests. It is the test referred to in paragraph 25 of the Revised General Introduction to the Guidelines; it got its name from the fact that it uses plus and minus signs rather than quantitative measures as its data. The only assumption is that the variable under consideration has a continuous distriution.
The hypothesis tested is that in a series of differences of matched observation scores, the number of postitive differences (the +'s) equals the number of differences with minus signs (-'s).
For large samples (n > 20 to 25) the normal approximation to the binomial distribution can be used. Tied observations are dropped from the analysis as no sign can be assigned.

The Wilcoxon matched pairs signed rank test. This test takes the direction as well as the magnitude of the differences into consideration. That is, it gives more weight to a pair with a large difference as it does to a pair with a small one. The statisctic to be evaluated is T, the smaller sum of like signed ranks. For large samples (n > 20 to 25) the normal approximation can be used (with or without a correction for ties).

PARAMETRIC TESTS
For characters measured in at least an interval scale,like plantheight, plot means are submitted to a two-way analysis of variance according to the model:

$$Y_{ij} = \mu + v_i + r_j + e_{ij}$$

in which μ = general mean

v_i = effect of variety i

r_j = effect of replication j

a_{ij} = residual error

Table 2 shows the matching ANOVA-table and the testing procedure for differences of variety means.

Source	dim	Mean Square	Testing procedure
Level	1		
Replications	r-1	MS_r	
Varieties	v-1	MS_v	——————|
Error	(v-1)(r-1)	$MS_a (=MS_{v*r})$	| F_1
			<----------
Total	rv		

Table 2. Within years analysis of variance.

If $F_1 = MS_v/MS_e$ is significantly exceeding 1 (1% probability), the Least Significant Differences for variety means is calculated according to

$$LSD = t_{\alpha\,(r-1)(v-1)} * \sqrt{\frac{2MS_e}{r}}$$

This LSD 1%-value, which should be obtained in 2 consecutive or in 2 out of 3 years, was the threshold for measured characters in the UPOV-member states.

This criterion was subject of discussion for some years in the UPOV Technical Working Party on Automation and Computer Programs, as it can be criticized on several grounds. When many pairs of differences are tested, some that show up to be significant are almost certain to be found. A multiple range test (e.g. Newman-Keuls, Duncan) would therefore be more appropriate. However, the decision whether to accept or refuse a candidate variety will then be affected by the number of other varieties in the trial and their relative position within the variety set and not only by the actual difference between varieties. For testing on distinctness, the comparison bewteen two varieties should be independant of other varieties in the same trial.

Further, the 2/3-criterion does not take into account the difference which just fails to achieve the 1% significance level. This leads, for example, to rejection of one 1% result and two 5% results, although the two 5% results are considered to provide at least as strong confirmatory evidence as only a second 1% result. On the other hand, two +1% results and one -5% result are accepted for distinctness with the 2/3 criterion. To overcome this weakness, the "t-score criterion" was used in some countries as a "second line of defence". The relationship between t-scores and t-values (df $\approx\infty$) is given in table 3.

Probability level	t-value (t)	t-score (ts)
$p > 0.05$	$t < 2.0$	ts = 0
$0.01 < p \leq 0.05$	$2.0 \leq t < 2.6$	ts = t
$0.001 < p \leq 0.01$	$2.6 \leq t < 3.4$	ts = t
$p \leq 0.001$	$t \geq 3.4$	ts = 3.4

Table 3. Relationship between t-values and t-score (df $\approx\infty$)

0851

Distinctness is now determined by

$$T = \left| \sum_{i=1}^{3} ts \right|$$

and

$$K = 2*t_{df}^{0.01}$$

Two varieties are considered distinct if $T \geqslant K$ ($K = 5.2$ for df $\approx\infty$)

As a more solid solution to achieve consistent variety differences, a "combined over years" (COY)-analysis was proposed to the Technical Committee based upon the model

$$y_{ij} = u+v_i+m_j+(vm)_{ij}+e_{ijk}$$

in which v_i = effect of variety i

m_j = effect of year j

$(vm)_{ij}$ = interaction var*year

with its ANOVA-table shown in table 4, and LSD to be calculated as

$$LSD = t_{\alpha\,(v-1)(m-1)} * \sqrt{\frac{2MS_{v*y}}{m}}$$

Source	dim	Mean Square	Testing procedure
Level	1		
Years	m-1	MS_y	
Varieties	v-1	MS_v	------|
Interaction V*Y	(m-1)(v-1)	MS_{v*y}	<------- F_1
Error	mv(r-1)	$MS_e (=MS_{v*r})$	----------|
Total	mvr		<---------- $F_2=\lambda^2$

Table 4. Over years analysis of variance.

Here again, plot means are submitted to the ANOVA.

The inconsistency of characters is indicated by

$$\lambda = \sqrt{\frac{MS_{v*y}}{MS_e}} \qquad \text{(see table 4)}$$

λ-values tend to differ considerably from country to country, in that respect that they are generally higher in the one country than they are in the other. Therefore, it is not quite surprising that, with respect to continuity of the proportion of positive decisions, a change of distinctness criterion would cause more serious problems in the one country than it does in the other.

Therefore, it was proposed to overcome this problem by applying a Modified Joint Regression Analysis according to the model

$$y_{ij} = \mu + \beta_j v_i + m_j + e_{ij}$$

in which β_j = proportionality factor for year j.

This means that, if the regression of the observed values on the mean values of the testing period is significantly deviating from 1 in a particular year, those year-results are adjusted according to that regression before being submitted to the analysis of variance.

MULTIVARIATE ANALYSIS

In fact, the convincement of distinctness between varieties is more often than not based on the total expression of characters rather than on a single character. Therefore, multivariate analysis would be more appropriate.
In its simplest way, multivariate analysis can be considered as an expansion of Pythagores' theoreme over more dimensions.
Many multivariate distance measures have been developed, taking into account the different scales of measurement, the absence on presence of correlations between characters and the relative importance of characters by weighing them. One of them, the Mahalanobis Distance D^2, is under evaluation by the Technical Working Party on Automation and Computer Programs in order to find the closest variety on measured characters.

These techniques should be elaborated on further for inclusion in the process to find distinctness between varieties. The development of a proper similarity index is of utmost importance when discussing distinctness between varieties and important characteristics.
This especially holds when a system of dependant breeders' rights will be established.

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