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UPOV

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INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS

GENEVA

TECHNICAL WORKING PARTY FOR AGRICULTURAL CROPS

Twenty-second Session

Christchurch, New Zealand, November 23 to 27, 1993

REPORT

adopted by the Technical Working Party for Agricultural Crops

Opening of the Session

1. The twenty-second session of the Technical Working Party for Agricultural Crops (hereinafter referred to as "the Working Party") was held in Christchurch, New Zealand, from November 23 to 27, 1993. The list of participants is reproduced as Annex I to this report.

2. Mr. J. Belgrave, Secretary of Commerce, and Mr. Bill Whitmore, Commissioner of the Plant Variety Rights Office, welcomed the participants to New Zealand. The session was opened by Dr. M.S. Camlin (United Kingdom). As agreed during the last session of the Working Party, Dr. Camlin had made the preparations for and chaired the present session as the new Chairman, Mr. Huib Ghijsen (Netherlands) had only been elected by the Council in October 1993.

Adoption of the Agenda

3. The Working Party adopted the agenda of its twenty-second session as reproduced in document TWA/22/1 Rev.

Important Decisions Taken During the Twenty-Eighth, Twenty-Ninth and Thirtieth Sessions of the Technical Committee

4. Dr. M.-H. Thiele-Wittig gave a brief report on the important decisions taken during the last session of the Technical Committee, referring to the short report on that session reproduced in document C/27/10 Add.2 and to document TC/30/6 Prov. which was still under preparation.

5. The Working Party also noted documents TC/28/6 and CAJ/32/10-TC/29/9 on the twenty-eighth and twenty-ninth sessions and document TWA/22/11 on DUS Tests for Seed Color of Turnip and Turnip Rape, prepared by experts from the United Kingdom. It had a short discussion on the question of essential derivation and agreed to continue its discussions on that subject during its next session when discussing the outcome of the second session of the BMT. It agreed that it was not for UPOV to take decisions in that field but only to do research and supply the necessary tools to measure the rate of similarity between a variety and its claimed essentially derived variety.

6. Participation of Experts From International Organizations in Sessions of the Technical Committee.- The Working Party noted that in future--in addition to the European Commission which is already routinely invited--experts from the following international organizations would also be invited to sessions of the Technical Committee:

FAO	Food and Agriculture Organization of the United Nations
IBPGR	International Board for Plant Genetic Resources
ISTA	International Seed Testing Association
OECD	Organisation for Economic Co-operation and Development
ASSINSEL	International Association of Plant Breeders for the Protection of Plant Varieties
CIOPORA	International Community of Breeders of Asexually Reproduced Ornamental and Fruit-Tree Varieties
COMASSO	Association of Plant Breeders of the European Economic Community.

7. Distribution of Documents of the Technical Committee.- The Working Party furthermore noted that the Council had agreed that documents prepared for the Technical Committee would not be considered of a restricted nature and, consequently, could be made available to any interested expert.

8. Uniformity of Seed Color in Turnip Rape.- Dr. Bould (United Kingdom) introduced document TWA/22/11. He described the background to the question of seed color in Turnip Rape and explained that, with the breeding aim of increased oil content, the problem of a yellow seed color which was not uniform would be more important. The Working Party finally proposed, rather than following the recommendation in document TWA/22/11, to ask the TWV to delete the characteristic on seed color for Turnip Rape from the Test Guidelines as it was not considered to be a reliable characteristic. In the remarks on the description of Turnip Rape varieties the actual percentage of yellow seed should be stated and a remark should be introduced stating that a

mixture of yellow and brown seed should not automatically lead to rejection of the variety because of lack of uniformity, as the mixture might be genetically justified.

9. Resistance to Disease.- The Working Party noted document TC/30/5 as well as a report of the discussions which had taken place in the Technical Committee on the testing of resistance to disease and noted that the Technical Committee had requested the Technical Working Parties to rediscuss the question and collect information on resistance. The various experts should contact breeders and pathologists in order to obtain better information. The Office of UPOV would then prepare a document containing as much information as possible to enable the Committee to make progress during its next session and to agree on definitions, the exact terms (if possible those used by the breeders and/or users of the varieties), and to decide what was acceptable for use in distinctness testing and what not.

10. The Working Party agreed that all experts would send their comments on documents TC/30/5 and TC/XX/10 to Mr. Ghijsen (Netherlands) before the end of February 1994, so the latter might prepare a document for the next session before the end of March 1994.

UPOV Central Computerized Data Base

11. The Working Party noted the history of the discussions concerning a possible UPOV central computerized data base as laid down in document CAJ/32/2-TC/29/2 and Circulars U 2047 and U 2067. It also noted the preparation by the TWC of a format for electronic exchange of information published in national gazettes as laid down in document TWC/11/15. Although in the first instance not intended for the establishment of the UPOV data base, the document would also be applicable in its present form for that purpose since page 6 of the document in particular took account of the special requirements. Some selected experts had met in an ad hoc working group and had applied the format to a reduced number of data at the national level, exchanged those data and improved the format on the basis of the experience gained. The Council, during its session in October 1993, had approved the preparation of a prototype for a UPOV Data Base. A further meeting of the ad hoc working group on format had taken place on November 9 and 10, 1993, during which the format had been finalized. It could now be given to a firm to develop a prototype on the basis of data to be supplied in that format by the Offices participating in the ad hoc working group. The Working Party welcomed the progress made and proposed the species potato as the agricultural species for the preparation of the prototype.

Survey on the Use of Electrophoresis by the UPOV Member States

12. Dr. Camlin (United Kingdom) introduced a summary of answers received to a questionnaire distributed during the session and reproduced in Annex II to this report. The meeting noted further information given by experts from France. It agreed to ask Dr. Camlin to prepare an updated version of the summary for the next session of the Working Party and requested those States that had not yet sent in their information, to do so. The updated summary would be restricted to agricultural species only.

Statistical Methods

13. Combined Over-Years Analysis for Distinctness (COYD) and for Uniformity (COYU).- The Working Party noted the most recent versions of the COYD and COYU analyses as reproduced in document TC/30/4. It noted the approved new levels fixed for the COYU as well as those for the transitional period foreseen for some countries encountering difficulties in the immediate application of the new levels. It furthermore noted the recommendation of the Technical Committee to encourage the members to apply the new criteria.

14. The Working Party had a lengthy discussion on the species to which the COYD method was applicable. Some experts were of the opinion that it was studied for, and thus applicable mainly to, cross-fertilized grass species. Others saw no reason why it should not be applicable to all cross-fertilized species or even to self-fertilized crops, provided that the necessary measured data was available (while admitting that in most cases that might not be the case). The Working Party finally confirmed the decision of the Technical Committee as reproduced in paragraphs 22 to 24 of document TC/XXV/11 and paragraphs 23 and 24 of document TC/28/6, stating that

> TC/XXV/11:
> "22. ...The Committee agreed to and adopted the TWC's recommendation to replace the present distinctness criterion for grasses by the COY analysis, including the Modified Joint Regression Analysis (MJRA) option.
>
> 23. ...It finally adopted a 1% significance level after two years of tests and the same significance level after three years of tests. A transitional period of three years was decided for those member States which foresaw difficulties in the introduction of the new significance level to grasses.
>
> 24. ...It asked the TWA and the TWV to apply wherever possible the COY analysis to agricultural and vegetable species."
>
> TC/28/6:
> "23. ...The Committee agreed that it was important to encourage more member States to change to the COYD analysis and to apply it not only to grasses.
>
> 24. ...The Committee encouraged the use of the long-term LSD method for all those cases where the minimum of 20 degrees of freedom for an application of the COYD analysis was not reached because of the reduced number of varieties in the test."

15. Balance of Risks in the Testing of Uniformity.- The Working Party noted the explanation (given in document TWC/11/16 prepared by the TWC) of the balance of the risks of wrongly rejecting a homogeneous variety as heterogeneous and of wrongly accepting a heterogeneous variety as homogeneous, as well as the influence of the sample size on those risks. It noted that the Technical Committee had approved the new document (TWC/11/16) as the replacement for paragraph 28 of the General Introduction to the Test Guidelines requiring inclusion, in all draft Test Guidelines discussed, of the population standard, the acceptance probability and the number of off-types tolerated with the stated sample size. It also noted the corrections to be made on page 6 and proposed to delete on page 3 the column referring to document TC/XXV/8 as that document was no longer applicable.

16. The Working Party had a lengthy discussion on the criteria for the selection of the right population standard. It discussed the differences in requirements for certification, post control and plant variety protection. There was no conflict due to different standards between these three groups. Even within the certification system, different standards were applicable to basic seed and certified seed. The standards might also be different depending on the mode of propagation, e.g. self-fertilization or cross-fertilization. The main criteria for the decision would be the knowledge available and the effect of accepting a given percentage of off-types in the variety.

17. The Working Party asked the expert from France to check the handling of off-types in the adopted Test Guidelines for agricultural species and to prepare, if the Test Guidelines contained sufficient data to do so, a list with the population standards applied in thoses documents. For the documents to be completed during the present session, the population standard would, if possible, be fixed species by species.

18. The Working Party proposed to clarify the range of application of documents TC/30/4 and TWC/11/16 and to combine them into a single document of which document TWC/11/16 would form Part I, applicable to vegetatively and self-fertilized crops, and document TC/30/4 would constitute Part II, applicable to cross-fertilized crops. As the wording of document TC/30/4 was not yet sufficiently simple for easy understanding, Dr. Camlin (United Kingdom) would contact the authors (Dr. Weatherup and Dr. Talbot, United Kingdom) and cooperate with them in producing an amended, simplified version. At the same time, the document should also state, in a similar way to document TWC/11/16, the necessary alpha-risk and beta-risk figures and advise on the risks taken if applied to other crops. It should, furthermore, make reference to the Long-Term LSD method and its use in cases of less than 20 varieties and less than 12 degrees of freedom.

General Discussion on the Consequences of the Introduction of New Characteristics in the Test Guidelines

19. The Working Party noted with interest the information contained in document TC/28/5 on identification and distinctness and the report on the first session of the BMT as reproduced in document BMT/1/4. It had a lengthy discussion on acceptability of methods which did not distinguish between the expressed and unexpressed part of the genome. It confirmed that there was a need for genetic knowledge of the expression of a marker. It was possible to use a technique if there was sufficient knowledge on the strict link between a characteristic and a marker. Reference was made in this respect to the case where two varieties were both male sterile, but where that male sterility was controlled by different genes in the two varieties and where that different control could be proven only via a marker. It was also agreed that one should aim at finding solutions and a philosophy similar to that found in the case of electrophoresis in cereals where the method was only accepted if a difference at allele level could be made. There was no harm in using banding patterns as an additional item of information for description purposes, but they should not be used alone for a decision on distinctness.

DNA Techniques

20. The Working Party agreed to follow closely the discussions in the BMT Working Group. It noted that, according to the decision of the Technical

Committee, invitations to BMT sessions should be sent to the Technical Committee members, thus automatically including the chairmen of the Technical Working Parties, and that it would be left to each member State to decide which experts should participate in the BMT session.

21. Mr. Kethro (Australia) introduced document TC/28/5 prepared by experts from Australia. He concluded that the paper expressed itself in favor of the use of the RAPD method rather than the RFLP method. The breeders present during the meeting reported that they had certain reservations on the use of an average rating over all bands as was done in the RAPD method. At present, none of the private breeders in New Zealand would work with DNA-profiling and electrophoresis would only be used in support of data obtained through other characteristics. With electrophoresis, but more so with DNA-profiling, there was a danger of a "breeder" using those methods to create differences only for the sake of a difference. They preferred a simpler and more direct approach. Complex and more expensive methods should be excluded, especially as they were not needed at present.

22. The Working Party also noted that the RAPD method, although it might be reproducible in one laboratory, lacked reproducibility between laboratories. Different apparatus used would lead to different results. In addition, when used for similarity tests, it could only detect similarity of bands but could not give sufficient information on the similarity of the genetics. It was important to have a more robust method and to obtain genetic interpretation of the results. Without that genetic interpretation there was the risk of influence on the band pattern of many non-genetic factors.

23. Mr. Guiard (France) introduced document BMT/1/3 prepared by experts from France for the first session of the BMT. He highlighted the advantages and limits of the DNA methods and the need to limit the discussions, at least in the beginning, to a small number of methods in order to make progress. It was not the task of UPOV to discuss the techniques of many different methods but to discuss the use of information resulting from their application for UPOV purposes. The question of uniformity should also be considered. If used for distinctness purposes, uniformity was required. For essential derivation purposes, heterogeneity would not be an obstacle. As with these methods it was almost always possible to find a difference between two varieties and even between two plants, there was a need to combine the differences found with differences identified by other means (e.g. electrophoresis or morphological characteristics). If this was possible, the question whether the DNA stemmed from the expressed or unexpressed part of the genome would be secondary.

24. Other experts expressed the need to establish clear rules regarding the number of differences needed for distinctness. Would the introduction of one single gene through genetic engineering be enough? The methods should also be made more robust. Even in the case of RFLPs, which were more easily reproducible between laboratories than the RAPD method, the experience in Europe was that several probes which apparently had worked well in the United States, did not lead to the same results in France. Also with RFLPs it was thus necessary to define the enzyme probes and to select certain probes. In this respect, the problem was similar to that encountered in electrophoresis of isoenzymes. The use of microsatellites had to be given special attention too.

25. Some experts noted that there seemed to be a slight tendency for countries with a breeders testing system to be more open and willing to accept the new methods. However, countries should not be allowed to go separate

ways. The new methods also seemed to favor larger breeding companies to the detriment of smaller breeders and applicants for new varieties to the detriment of owners of existing protected varieties as they reduced the minimum distance between varieties. There was thus a need to maintain a proper balance between all sides.

26. The breeders also drew attention to the costs involved as varieties protected with the help of differences shown by these methods would require higher maintenance costs. Therefore, as in the case of electrophoresis, the methods should only be used to allow additional optional characteristics as a last resort for the breeder and only if the breeder accepted the greater cost and effort.

27. In a survey made during the session, the following species were mentioned for which DNA methods were under study: maize, oil seed rape, potato, ryegrass, soybean, sunflower and tomato.

Cooperation With Breeders in the Testing of Varieties

28. The Working Party noted the declaration on the conditions for the examination of a variety based upon trials carried out by or on behalf of the breeder, as set out in Annex II to document CAJ/32/10-TC/29/9, which had been finally approved by the Council during its October session.

29. Mr. Ghijsen (Netherlands) introduced document TWA/22/12, highlighting the differences between the different testing systems in the member States. Ms. Sisson (Canada) explained Annex II to that document, updating its information. The introductions were followed by a lengthy discussion and several detailed explanations of the differences in testing in the different member States. From those discussions it became clear that there was an almost gradual change from a testing system where the breeder or applicant did almost everything to a system where the Office took over completely.

30. At the one extremity, the applicant or breeder received a rather rough protocol and the details and selection of example varieties and similar varieties was left to him; other countries prescribed certain example varieties to be grown or discussed details of the protocol with the breeder. In some countries, the breeder also did the observations and an official examiner would pass by once during the growing of the variety to check whether the variety was really being grown and to observe a few characteristics. If the applicant had proven to be reliable in earlier cases, the examiner might not visit the growing test at all. In other countries, the examiner came several times to make observations. In yet other countries, an expert accredited with the PVR Office as a qualified person (QP) supervised the whole growing trial and did the observations. In certain cases, this qualified person could even be the applicant. While in some countries the applicant or breeder prepared the variety description, in others it was the qualified person or the examiner. In some countries, only a preliminary decision on the DUS test was prepared by the breeder and then published with a six months' period for objections. In others, the examiner prepared a proposal for a decision, to be approved by the Commissioner on the basis of data received either direct from the applicant or breeder or, in other countries, from a qualified person. However, even in countries with a prevailing breeders testing system, a centralized system had been installed for certain species where breeders and applicants for other varieties agreed to combined growing on the premises of a person contracted by the applicants. The main reasons

for that change had been the increase in the number of varieties and applicants. There might be a tendency, with the increase of the schemes for more species, for a shift to the central testing to take place in some countries.

31. At the same time, a shift could be noticed in some of the countries with a mainly government testing system, towards letting the breeder do part of the testing. In some countries, the applicant or breeder was asked to do a one-year test for certain species which, if the data agreed with those observed by the official testing authority in the second year, could lead to protection being given after only one year of official tests. In other countries which had opened the protection system to the whole plant kingdom or a large number of species, for some "smaller" species with few varieties and applicants, the breeder or applicant would grow the variety on his premises and either do the observations according to a detailed protocol (more detailed and precise than the UPOV Test Guidelines) or the examiner would come to the premises to do the observations.

32. Several experts mentioned that the costs involved were often a decisive factor in the choice of the testing system as in more and more countries 100% cost coverage through the fees paid by the applicant was required. Attention should be paid to the level of the fees for minor species to avoid a situation where breeders saw no commercial benefit in the protection system and refrained from applying for breeders' rights.

33. In order to get a better understanding of the differences in the various member States, the Working Party asked the Office of UPOV to prepare a questionnaire requesting each State to say, before the end of April 1994, who (i.e. the Office, the breeder or others) was responsible for what aspect in the testing procedures.

Testing on One or Several Sites

34. The Working Party noted document TWA/22/7 containing a motion from the fodder crop section of ASSINSEL on testing at one site only. It lacked time for a detailed discussion. It was however mentioned that the choice of one or several sites for testing was at present left to the discretion of the individual member States.

Report From the Subgroup on Electrophoresis in Cereals

35. Dr. Camlin (United Kingdom) introduced document TWA/22/3 summarizing the report on the last Subgroup Meeting on Cereals. It concluded that electrophoresis characteristics should be included in the Test Guidelines and not in an annex. They should not be given an asterisk (*). It was left open whether they could be used alone or only in combination with other characteristics. It was proposed that each locus should form one characteristic and each allele one state of expression. For glutenins for wheat and hordeins for barley, three loci each were proposed. For gliadins for wheat and for avenins for oats there was not enough information on the genetics available to accept their inclusion in the Test Guidelines. The Working Party confirmed that position and agreed that it was essential to have sufficient information on the genetics of the bands before electrophoretic characteristics could be included in the UPOV Test Guidelines. The expert from the United States of America stated that it was not possible for his

Office to reject a characteristic if its observations was based on a generally recognized published method. His country could therefore not follow that restricted interpretation of UPOV.

Test Guidelines for Wheat

36. The Working Party noted the draft Test Guidelines for Wheat (Revision) as reproduced in documents TWA/22/9 and TWA/22/10 and made the following changes to document TWA/22/10:

(i) Table of Characteristics:

Characteristics

11 To have the same order of states of expression as in the Test Guidelines for Durum Wheat

19 To have the Notes 1, 3, 5, 7, 9

22 To have the asterisk deleted

27 To have the third state read: "no band"

28 To have an additional state "band 21 (Foison)(9)" checked by all experts before the next session for its possible inclusion and to have the spelling of the example varieties "Courtot, Carala" corrected.

In addition, several example varieties were amended in an ad hoc Subgroup meeting.

(ii) Explanations to the Table of Characteristics: To have the Note on page 31 below the tables amended to read: "Certain bands (e.g. 9 and 10) have similar molecular weights, but can be differentiated from one another by their known association with other bands (i.e. band 9 with band 7 for characteristic 28 and band 10 with band 5 for characteristic 29. For characteristic 28, band 13 is always associated with band 16, band 14 always with band 15 and band 20 is always alone."

(iii) The Working Party had a lengthy discussion on the population standard and the aceptance probability to be chosen. It finally agreed not to change paragraphs 2 and 3 of Chapter III of the notes but to ask the TWC to clarify the criteria for the correct choice in the case of different tests in ear-rows and in drilled plots. The main question was whether the population had to remain the same, independent of the type of trial, and only the acceptance probability changed (alpha-1 for ear-rows and alpha-2 for drilled plots) in order to reach the number of off-types accepted at present (3 in 100 ear-rows, 5 in 2,000 for drilled plots), or should the acceptance probability be kept the same for both trials and the population standard adjusted (P1 for ear-rows and P2 for drilled plots) depending on whether one considered ear-rows or drilled plots. Other experts considered that, as characteristics in drilled plots were observed together while in ear-rows they were observed individually, a different population standard was applicable for the observation of individual characteristics vis-à-vis the observation of several characteristics together.

Test Guidelines for Barley

37. The Working Party noted the draft Test Guidelines for Barley (Revision) as reproduced in documents TWA/22/9, TWA/22/16 and TWA/22/16 Rev. and made the following changes in the Table of Characteristics of document TWA/22/16 Rev.:

Characteristics

14,21 To have the Notes changed to "3, 5, 7"

21 To have the word "its" inserted before "awn" and to have the explanations amended

24 To have the asterisk deleted

28 To have the first state read: "whitish"

30,31,32 To have an additional explanation inserted on page 29 reading: "The band patterns presented in the tables for D, C and B hordeins are schematic and differences in band intensity have been ignored in the presentation." and on page 36 an additional explanation reading: "In comparing the Acid PAGE and SDS PAGE methods, it should be noted that the example varieties and Notes given for the individual states are identical in both methods." In addition, the citations of authors on pages 4, 36, 37, 38, 39 and 40 were deleted.

In addition, a few example varieties were amended in an ad hoc Subgroup meeting.

Test Guidelines for Oats

38. The Working Party noted the draft Test Guidelines for Oats (Revision) as reproduced in documents TWA/22/9 and TWA/22/15 and, in an ad hoc Subgroup meeting, amended only a few example varieties in document TWA/22/15.

Discussion on Working Papers on Test Guidelines

Test Guidelines for Peas (Revision)

39. The Working Party noted the draft Test Guidelines for Peas (Revision) as reproduced in document TG/7/6 Prov. (which had been referred back to the TWV and TWA by the Technical Committee) and document TWA/22/14 containing, in handwriting, several proposals for amendments or questions raised. It had a lengthy discussion on the differences between the uniformity of garden pea varieties and agricultural pea varieties with respect to some selected characteristics. As a result of different requirements and different breeding pressures in the different areas, agricultural pea varieties showed in certain characteristics for which they were not tested lower degrees of uniformity which could entail the risk of rejection for lack of uniformity if those characteristics were used for testing. Some of these characteristics were however extremely important for the testing of vegetable pea varieties and were used for their grouping. As one Test Guidelines document will be established for all pea varieties, a solution had to be found which took the needs of both groups into consideration. The following three possibilities could be considered: (a) to delete the characteristics in question, (b) to

remove the asterisk (*) for those characteristics, or (c) to state that certain characteristics applied to garden pea varieties only. The Working Party finally opted for possibility (c) and agreed that characteristics 50, 51 and 61 of document TWA/22/14 would have no asterisk (*) and would apply to garden peas only. They would appear nevertheless in the grouping chapter and in the Technical Questionnaire. In addition, characteristics 13 and 17 would have no asterisk (*) either, but characteristic 13 would still appear in the Technical Questionnaire. The explanation to characteristic 52 would state that the observations should be made on the fully developed pod. Apart from the above changes, the Working Party left the other comments to be handled by the TWV.

Test Guidelines for Maize (Revision)

40. The Working Party noted that the Technical Committee would await the outcome of the Working Party's present discussions as well as those in its Subgroup on Maize before taking a final decision on the definition and examination of hybrid varieties. The Working Party noted the report of the Subgroup on Maize as reproduced in document TWA/22/2 and explained by Mr. Guiard (France), Chairman of the Subgroup on Maize. It furthermore noted the explanations by Mrs. Bourgoin (France) on the study of electrophoresis in Maize. It agreed that for the inclusion of electrophoretic characteristics in the Test Guidelines for Maize the same criteria should apply as agreed upon for the Test Guidelines for Wheat and for Barley. It asked the Subgroup to continue in the envisaged way during its coming meeting in Budapest, Hungary, on February 22 and 23, 1994, and would consider the outcome at its next session in May 1994.

Test Guidelines for Rape (Revision)

41. The Working Party noted the report of the Subgroup on Rape as reproduced in document TWA/22/4 and commented on by Dr. Fuchs (Germany), Chairman of the Subgroup. It also noted the results of a questionnaire reproduced in document TWA/22/13. It had a lengthy discussion on several of the questions mentioned in both documents, especially whether the components needed to be distinct if protection was requested for the hybrid only. The majority took the view that in that case distinctness was not necessary. On the question whether male sterility was a distinguishing characteristic, the majority took the view that even if that might not be the case, some other morphological changes might occur with male sterility which would enable the variety to be distinguished. Consequently, it was important to request protection for both the fertile and the sterile form and to have both in the reference collection. The Working Party finally asked the Office of UPOV to prepare a new document on the basis of the draft prepared by the Chairman of the Subgroup and distributed during the session.

Test Guidelines for Flax (Revision)

42. The Working Party noted the draft Test Guidelines for Flax (Revision) as reproduced in document TWA/20/5 and the changes agreed upon during its session in Beltsville, USA. It agreed that the experts from France would produce a new document by the end of March 1994 for discussion during the next session.

Test Guidelines for Fodder Beet

43. The Working Party noted the draft Test Guidelines for Fodder Beet as reproduced in document TWA/22/5 and introduced by Miss Rasmussen (Denmark), and made the following changes to that document:

(i) Methods and Observations: In paragraphs 1 and 2 the word "approx." was deleted.

(ii) Table of Characteristics:

Characteristics

2 To receive the additional state "polyploid (5)" with the following note in the explanations: "5. Polyploid: The variety is neither diploid, nor triploid nor tetraploid."

3 To have the second part of the explanations replaced by the following wording: "In the case of varieties with mixed color, the characteristic should not be used for distinctness purposes. However, the mixed nature of a variety should not be considered as a lack of uniformity."

5 To read: "Leaf blade: green color" with the states "light, medium, dark"

19 To have the word "rosy" replaced by "pink" and state 2 to read: "white to yellow"

Test Guidelines for Soya Bean (Revision)

44. The Working Party noted the draft Test Guidelines for Soya Bean (Revision) as reproduced in document TWA/22/6 and the oral report given by Mr. Atchley (USA), Chairman of the Subgroup on Soya Bean which had met on November 22, 1993. It asked for the information on Soya Bean resistance received from the experts from the USA to be annexed to this report (see Annex III). The Subgroup had made the following changes to document TWA/22/6:

(i) Material Required: The minimum quantity of seed to be supplied by the applicant in one or more samples should be 1 kg.

(ii) Conduct of Tests: The second part of paragraph 3 to be worded as in the Test Guidelines for Wheat but with the figure of 200 plants. Paragraph 4 and the rest of the notes up to the Table of Characteristics to be deleted and replaced by the standardized wording as in other Test Guidelines (e.g. Wheat).

(iii) Methods and Observations: To copy the last two lines of paragraph 3 of the conduct of tests and to insert paragraph 1 of the Test Guidelines for Wheat and a paragraph with the population standard of 1% and an acceptance probability of 95% with maximum 5 off-types in 200 plants.

(iv) Table of Characteristics:

Characteristics

1 To be split into two characteristics, the first with an asterisk and the states "absent(1), present(9)", the second with the states from "very weak(1)" to "very strong(9)"

2 To receive an asterisk and an additional state "semi-determinate(2)", the expert from France to supply the expert from the USA with the testing method, example varieties and a new drawing

3.2 To have the indication of "cm" deleted

3.3 To be observed at flowering in the central third of the stem

4.1 To receive an asterisk, to be observed as characteristic 3.3, to receive drawings to be supplied by the expert from France and to have the states "lanceolate(1), lanceolate to rhomboidal(2), rhomboidal(3), pointed ovate(4), rounded ovate(5), elliptic(6)"; before this characteristic a new characteristic to be inserted reading: "Leaf: intensity of blistering (at flowering)" with the states from "absent or very weak(1)" to "very strong(9)"

4.2 To read: "Intensity of green color (at beginning of flowering)" with the states "light, medium, dark" and to be placed after characteristic 3.3

5 To be observed as characteristic 4.1, to be split into three characteristics:

(i) "length" with the states from "very short(1)" to "very long(9)"
(ii) "width" with the states from "very narrow(1)" to "very broad(9)"
(iii) "ratio length/width" with the states from "very small(1)" to "very large(9)"

6 To receive the additional state "pink(3)" if the expert from the USA could provide an example variety

7 To receive an asterisk and to read: "Pod: intensity of brown color (at maturity)" with the states "light, medium, dark"

8.1 To receive an asterisk and to have the indication of actual growth deleted

8.3 To receive an asterisk

8.4 To receive an asterisk and to have the states "grey(1), yellow(2), light brown(3), dark brown(4), imperfect black(5), black(6)"; after this characteristic, a new characteristic to be inserted reading: "Seed: persistance of hilum tendril" with the states "absent, present"

8.5 To receive the method to be stated by the experts from the USA

8.6 The expert from the USA to send methods to the expert from France, the expert from France to prepare a draft, similar to that for Wheat, of the methods to be distributed to the Subgroup by the end of March 1994 via the Office of UPOV

9 To be limited to "Sulfonylurea", to have the states "absent, present" and the expert from the USA to supply the method

10 To be deleted.

(v) Literature: The extensive list is to be limited to a few important items selected by the expert from the USA. The expert from France to cite literature on electrophoresis.

(vi) Technical Questionnaire: Characteristics 3.3, 6, 8.4 and 8.8 to be included in paragraph 5 of the Technical Questionnaire and in the Notes as grouping characteristics.

Test Guidelines for Subterranean Clover

45. The Working Party noted the draft Test Guidelines for Subterranean Clover as reproduced in document TWA/22/8 and a revised version of that document, distributed during the session, which was introduced by Mr. Kethro (Australia) and is reproduced as Annex IV to this report. It made the following changes to that document:

(i) Material Required: 30 g of seed to be supplied in one or more samples.

(ii) Conduct of Tests: To have the sentence "The seed should be inoculated with Rhizobium." inserted after the first sentence of paragraph 3. In addition, the new paragraph on the population standard and the acceptance probability to be inserted with figures yet to be decided.

(iii) Table of Characteristics:

Characteristics

1 To have the first state read: "absent or very weak"

2,22,33 To have the states "erect, semi-erect, adpressed"

5 To have the request for the actual figure deleted

9-15 To start with the word "Leaflet:"

9 To read: "Leaflet: size of arms" with the states from "absent or very small(1)" to "very large(9)"

10,12,15 To have the first state read: "very light green"

11 To have the states "narrow(3), narrow to medium(4), medium(5), medium to broad(6), broad(7)"

13 To have the word "apex" replaced by "distal end" and to have the Notes "1, 2, 3"

14 To read: "Leaflet: size of central crescent-shaped mark" with the states from "absent or very small(1)" to "very large(9)"

17,18,21,26,29,31,35 To be split into two characteristics, one with the states "absent(1), present(9)" and another with the degree of flecking/flusk/hairiness/anthocyanin coloration or the distribution of the area of pigmentation

19 To have the request for the indication of the RHS Chart Number deleted

20 To have the states "between distal end and leaf mark(1), around leaf mark(2), only along midrib(3), only along midrib and leaf mark(4), between leaf mark and base(5), at base (6)"

23,24,25 To have the states from "very low(1)" to "very high(9)", the expert from Australia to state the time of recording, the part of the organ to be recorded as well as the method to determine the amount of the isoflavones

26 Only the first of the split characteristic to receive an asterisk

27 To have the states from "very early(1)" to "very late(9)" and the request for the actual days to be deleted

28 To read: "Inflorescence: predominant number of florets" with the states "less than three, three, four, five, more than five"

29 The second of the split characteristic to have the states "on base of tube(1), on lower 1/4 of tube(3), on lower 1/2 of tube(5), on lower 3/4 of tube(7), on entire tube(9)" and with states with even Notes if needed for giving example varieties

30 To be checked whether all colors could really be identified separately and to receive example varieties to be given by the experts from Australia; to have the request for the RHS Chart Number deleted

32 To be observed at the central third of the length and to have the first state read: "absent or very weak(1)"

34 To have the second state read "medium"

35 To have the content of the brackets deleted, the first of the split characteristics to receive an asterisk, the second to have the states "weak(3), medium(5), strong(7)"

36 To read: "Plant: distribution of burr" with the first and last state to receive the addition "only"

37 To have the word "predominant" inserted before "number" and to have the same states as characteristic 28

39 To read: "Seed: weight" and to have the request for the indication of actual figures deleted

40 To read: "Percentage of hard seed four months after harvest" with the states from "very low(1)" to "very high(9)"

The experts from Australia to prepare by the end of March 1994 a new document also comprising explanations, a Technical Questionnaire and example varieties.

Status of Test Guidelines

46. The Working Party agreed that the draft Test Guidelines for Wheat (Revision), Barley (Revision), Oats (Revision) and Fodder Beet should be sent to the professional organizations for comments. It agreed to rediscuss the Test Guidelines for Maize (Revision), Rape (Revision), Flax (Revision), Soya Bean (Revision) and Subterranean Clover at its next session.

Future Program, Date and Place of Next Meeting

47. At the invitation of the expert from Spain, the Working Party agreed to hold its twenty-third session in Madrid from May 17 to 20 (noon), 1994. The Working Party planned to discuss or rediscuss the following items at its coming session:

(i) Report on the twenty-second session of the Working Party (TWA/22/17);

(ii) UPOV Central Computerized Data Base

(iii) Discussion on new technologies;

(iv) Survey on the use of electrophoresis in potatoes (DE to prepare a document by the end of March 1994);

(v) Testing of resistance against disease (NL to prepare a paper by the end of March 1994 on the present situation in the Working Party);

(vi) Statistical methods (FR to prepare, by the end of March 1994, a summary of the different population standards applied at present in the different Test Guidelines for agricultural crops);

(vii) Cooperation with breeders in the testing of varieties (the Office of UPOV to prepare a questionnaire and request answers by the end of April 1994);

(viii) Final discussion on draft Test Guidelines for:

- Wheat (TG/3/9(proj.))
- Barley (TG/19/8(proj.))
- Oats (TG/20/8(proj.))
- Fodder Beet (TG/150/1(proj.))

(ix) Discussion on working papers on Test Guidelines for:

- Maize (Revision) (TG/2/4, TWA/22/2 + report from the Subgroup)
- Rape (Revision) (TG/36/3, TWA/22/4 + UPOV to prepare a new document)
- Flax (Revision) (TG/57/3, TWA/20/5 + FR to prepare a document by the end of March 1994)
- Soya Bean (Revision) (TG/80/3, TWA/22/6 + US to prepare a new document by the end of March 1994)
- Subterranean Clover (TWA/22/8 + AU to prepare a new document by the end of March 1994).

48. The Working Party noted that the Subgroup on Maize would meet in Budapest, Hungary, on February 22 and 23, 1994.

Visits

49. In the afternoon of November 24, 1993, the Working Party visited the Canterbury Agriculture and Science Centre in Lincoln. It saw the centralized ryegrass trial fields and received background information on the PVR testing of agricultural species in New Zealand, on the history and development of the PVR system and on the reasons for establishing different systems for certain species. It received a description of the cooperative ryegrass trials and discussed several details. It received furthermore information on cereal maintenance and heard an introduction to crop and food research, plant improvement by gene transfer and the Ag Research work on ryegrass endophytes.

50. In the afternoon of November 27, 1993, the Working Party visited a farm near Christchurch where it received information on the local arable cropping practices. It further visited the PVR cereal trials at the Kimihia Research Center of Challenge Seeds Ltd., as well as the out-of-season-breeding nurseries. It received information on cereal maintenance at Pyne Gould Guinness Ltd. at Broadfields and on the PVR trials of cereals, peas and plantain and on the research and development projects in that area.

Visits in Australia

51. In the evening of November 28, 1993, the Working Party arrived in Canberra, Australia, where it was received by the Registrar of the Plant Variety Rights Office of Australia, Dr. Mick Lloyd, and Mrs. Margaret Winsbury. In the tour through Australia, Mrs. Shirley Gourgand of the PVR Office also participated.

52. In the morning of November 29, 1993, during a technical tour and in discussions with representatives from the Cooperative Research Center for Plant Science (CRCPS) and the Commonwealth Scientific Industrial Research Organization (CSIRO), the Working Party first received a short overview of the Australian Plant Variety Protection Office, followed by an introduction by Dr. Chris Buller to the organization of plant breeding in Australia. Thereafter followed a lecture by Dr. Rex Oram on cereal plant breeding. In the ensuing discussions, of special interest were the system of collecting levies from the growers when delivering cereals to the grain depots (distributed for R & D by the Grain Research Development Corporation) and the high percentage of farm-saved seed in cereals (which kills most incentives for private breeding in cereals). Thereafter, Mr. T.J. Higgins spoke on the "Genetic Engineering Approach to Plant Breeding," reporting on the different research fields (herbicide tolerance, virus resistance, insect resistance and modified ripening), the species involved and the first field tests approved by the Genetic Manipulation Advisory Committee. The lecture that raised by far the greatest interest was that by Dr. Matthew Morell on "Recent Advances in Molecular and Statistical Techniques for Varietal Identification." Starting with what had been said during the last BMT session in Geneva, Dr. Morell gave further information on recent developments and, in addition to the RFLP and RAPD methods, explained the Locus Specific PCR and compared the different advantages and disadvantages of these methods, especially in view of the background knowledge needed, speed, reliability, allele detection, genome coverage per test, specific information gained, development costs for a new species and the costs per one test. He referred to the analysis of the data obtained via AMOVA (Analysis of MOlecular VAriance), allowing comparison of different pairwise matrices, the calculation of a variance within and between populations and the production of significant values based on random permutation. It also enabled detection of whether particular primers showed differences between and/or within populations. As several experts present were also members of the BMT Working Group, they welcomed the idea of a detailed report during the next BMT session.

53. After the technicalities of the morning, a guided tour of the National Aquarium and Wildlife Park followed in the afternoon, which included a sheep shearing demonstration and (for several experts their first) contact with kangaroos, a guided tour through the new Parliament House and a cruise on Lake Burley Griffin. At dinner, Mr. Keith Glasson, Managing Director, Pioneer Hi-Bred Australia, addressed the Working Party, stressing in particular the importance of PVR in Australia to private breeders.

54. In the morning of November 30, 1993, the Working Party travelled from Canberra to Gunning, receiving on its way explanations from Mr. Ian McGowen (New South Wales Agriculture) on the different soils and farming practices in the area. In Gunning, it visited a farm especially well known for its conservation attitude. The farm was diversified with sheep, cattle and a tree nursery for soil conservation to restore the environmental balance affected by the cutting of trees and the increased dying off of the remaining trees.

55. In the afternoon of November 30, 1993, the Working Party visited the New South Wales Agriculture Station at Cowra where it saw the trial fields with grasses and clover, canolla, lupins, field pea and chicory and received information on the work of that station and a short report on the "Landcare Concept" of the Department of Conservation and Land Management which helps the farmers when problems arise (e.g. soil salinity, soil acidity, disease problems, etc.). The Working Party stayed the night on a farm at Millamolong, which provided a good insight into the farming practices and difficulties (acid soils, irrigation, structure degradation of soil, weed management, dependance on world prices, etc.) which were explained by the farm manager. It received an overview from Dr. Lindsay Cook on the climate and soil conditions in the different parts of Australia, separating it into a tropical North and a temperate South with large arid areas in the center, and on the structure of agriculture in Australia with its federal, state and local groupings.

56. On December 1, 1993, the Working Party drove to the Blue Mountains National Park. Mr. Wayne Brennan, Extension Officer at the Blue Mountains Heritage Centre, gave a detailed lecture with slides on the history of the park, its formation and flora and fauna, after which the Working Party was given a guided tour through part of the park.

57. On December 2, 1993, the Working Party returned to Sydney to depart from there to the various home destinations.

58. This report has been adopted by correspondence.

[Four annexes follow]

LIST OF PARTICIPANTS AT THE TWENTY-SECOND SESSION OF THE TECHNICAL WORKING PARTY FOR AGRICULTURAL CROPS CHRISTCHURCH, NEW ZEALAND, NOVEMBER 23 TO 27, 1993

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IV. OFFICER

Michael CAMLIN, Chairman
Huib GHIJSEN, elected Chairman

V. OFFICE OF UPOV

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[Annex II follows]

ANNEX II

UPOV

TECHNICAL WORKING PARTY FOR AGRICULTURAL CROPS

Agricultural species for which Member States study the possible use of electrophoresis or currently use electrophoresis in the examination of varieties

Species	Country	UNDER STUDY ONLY	IN USE				Plant Organ	Protein	Method
			(a) For Identification	(b) For Grouping	(c) For Distinctness	(d) For Homogenity			
Maize	Ca	X				X	Hypocotyl Seedling	Enzyme	SGE
	Cz	X					Coleoptile	Isoenzymes	SGE
	De	X					Seedling	Isoenzymes	PAGE SGE
	E	X					Cotyledon	Isoenzymes	?
	GB	X (Hybrid Purity)					Seed	Zeins	IEF
	Hu	X					Coleoptile	Enzymes	SGE
						X	Seed	Zeins	PAGE IEF
	Slov	X			X	X	Endosperm	Zeins	PAGE IEF
			X					Cotyledon	Isoenzymes SGE
Potato	Ca				X		Seed	[DNA]	[RAPD]
	Cz	X					Tuber	Peroxidases Esterases	PAGE
	De		X		X	X	Tuber	Albumins Globulins Isoenzymes	PAGE
	GB		X				Tuber	Proteins Esterases	PAGE
	NL		X				Tuber	Proteins Esterases	PAGE
	Slov	X					Tuber	Albumins Globulins Esterases	PAGE
Rape	Ca	X	For X		For X		Seed	[Ethanol Extractable] [DNA]	[RP-HPLC] [RAPD]
	De	X					Seedling	Isoenzymes	PAGE SGE IEF
	GB	X					Seed Seedling	Isoenzymes	IEF PAGE
Peas	Ca		X				Cotyledon	Acetic-Acid Soluble	PAGE
	GB	X	X				Seed	Storage Protein	SDS PAGE
	Slov	X					Seed	?	SDS PAGE

TECHNICAL WORKING PARTY FOR AGRICULTURAL CROPS

Agricultural species for which Member States study the possible use of electrophoresis or currently use electrophoresis in the examination of varieties

Species	Country	UNDER STUDY ONLY	IN USE				Plant Organ	Protein	Method
			(a) For Identification	(b) For Grouping	(c) For Distinctness	(d) For Homogenity			
Soyabean	Ca		X			X	Hypocotyl Seedling	Enzyme	SGE
	Slov	X					Seed	?	SDS PAGE
Sunflower	E	X					Cotyledon Seed	Isoenzymes Isoenzymes	? ?
	Hu	X					Seed	Albumins	SDS PAGE
Rice	Hu	X					Seed	?	SDS PAGE
Tomato	I	X	X				Seed Leaf	Isoenzymes	?
Egg Plant	I	X	X				Seed	Storage	SDS PAGE
Lentil	Ca				X		Seed	Protein	PAGE SDS PAGE
Bean (Phaseolus)	Slov	X					Seed	?	SDS PAGE
Bean (Faba)	GB	X					Seed	Proteins	SDS PAGE
Cauliflower	I	X	X				Seed	(Storage)	(HPLC)
Turnip Rape	GB						Seed	Isoenzymes	IEF PAGE

TECHNICAL WORKING PARTY FOR AGRICULTURAL CROPS

Agricultural species for which Member States study the possible use of electrophoresis or currently use electrophoresis in the examination of varieties

Species	Country	UNDER STUDY ONLY	IN USE				Plant Organ	Protein	Method
			(a) For Identification	(b) For Grouping	(c) For Distinctness	(d) For Homogenity			
Ryegrass	GB		X				Seed	Globulins General	SDS PAGE IEF
							Leaf	Isoenzymes General	SGE IEF
	NL		X				Seedling	Isoenzymes	PAGE
	NZ		X				Seed	Storage	SDS PAGE
Cocksfoot	GB						Seed	Globulins General	SDS PAGE IEF
							Leaf	General Esterases Peroxidases	IEF
	NZ		X				Seed	Storage Protein	SDS PAGE
Poa spp	GB		X				Seed	Globulins General	SDS PAGE IEF
	NL		X				Leaf	General Esterases Peroxidases	IEF
							Seed	Esterases	IEF
Festuca spp	GB		X				Seed	Globulins General	SDS PAGE
	NZ		X				Seed	Storage Protein	SDS PAGE
Agrostis spp	GB		X				Leaf	General Esterases Peroxidases	IEF
Bromus spp	NZ		X				Seed	Storage Protein	SDS PAGE
Holcus spp	NZ		X				Seed	Storage Protein	SDS PAGE
White Clover	GB		X				Seed	Storage Proteins General	SDS PAGE IEF IEF
							Leaf	Esterases Peroxidases General	IEF
Red Clover	NZ		X				Seed	Storage Protein	SDS PAGE
Alfalfa (Lucerne)	Ca	X	For X				Seed	[DNA]	[RAPD]

[Annex III follows]

ANNEX III

SOYBEAN CYST NEMATODE GENERAL INFORMATION

[note: In these data, compiled by Drs. Roger Boerma and Randall Shoemaker, the terms differentials, and differential reaction, refer to (as used in the PVPO) check varieties. Resistant or susceptible refers to the kind of check.]

Pathology: Soybean Cyst Nematode
Organism type: Nematode
Genus Species: Heterodera glycines
Authority: Ichinohe
Differentials:
Differential Reaction - = # of females and cysts on differential < 10% of Lee
Differential Reaction + = # of females and cysts on differential > or = 10% of Lee

Differentials: Peking
Differentials: Pickett
Differentials: PI88788
Differentials: PI90763

Standard Suscept. Germplasm: Lee
Protocol: 30-day greenhouse test
Reference: Riggs, 1991

Races: SCN 1 through SCN 16

Reference: Riggs, 1991

Disease Diagnostic symptom: lemon-shaped cysts on roots, stunting and yellowing of plants
Geographical distr(USA & Canada)
AL,AR,DE,FL,GA,IL,IN,IA,KS,KY,LA,MD,MI
MN,MS,MO,NE,NJ,NC,OH,OK,SC,TN,TX,VA,WI;
ONTARIO
Reference: Noel, 1992; Backman, 1989; Riggs, 1977

Geographical distr. (World): North America, South America, Asia
Reference: Noel, 1992; Backman, 1989; Riggs, 1977

Species host range: soybean, snapbean, lespedeza, tomato
Reference: Riggs, 1992

Comment: only species of economic importance have been listed

Pathology reaction: SCN Resistance
Resistance type: qualitative; vertical
Resistance reaction:
resistant = 0-9% # of females and cysts of susceptible
moderately resistant = 10-30% of susceptible
moderately susceptible 31-60% of susceptible
susceptible = >60% of susceptible
Protocol: greenhouse, laboratory or field
Reference: Schmitt, 1992; Noel, 1990

Pathology reactions: SCN Tolerance
Resistance type: quantitative, horizontal, low heritability
Tolerance Description: index (1-100%)
Protocol: field test
Reference: Hussey, 1992

Source of Information: Roger Boerma
Reviewed by: Richar Hussey, Georgia; Sam Anand, Missouri;
Robert Riggs, Arkansas
Grover Shannon, Delta and Pine Land Co.
A.P. Rao-Arelli, Missouri

SOYBEAN CYST NEMATODE RACE INFORMATION

Race: SCN 1
Differential value: Pickett: Resistant
Peking: Resistant
PI88788: Susceptible
PI90763: Resistant
Soybean Resistance: oligogenic characterization
Contact: Riggs Barker
Resistance Gene: rhg1
rhg2
rhg3
Source of Resistance: Peking
PI907063
PI84751
Reference: Caldwell, 1960
Source of Information: Roger Boerma

Race: SCN 2
Differential value: Pickett: Susceptible
Peking Susceptible
PI88788 Susceptible
PI90763 Resistant

Source of Resistance: PI90763
Contact: Riggs Barker
Reference: Hartwig, 1970; Hancock, 1987
Source of Information: Roger Boerma

PI437654
Reference Thomas, 1975
Myers, 1991
Source of Information Roger Boerma

Race : SCN 15
Differential value Pickett Susceptible
Peking Resistant
PI88788 Susceptible
PI90763 Susceptible
Source of Information Roger Boerma

Race : SCN 16
Differential value Pickett Resistant
Peking Susceptible
PI88788 Susceptible
PI90763 Susceptible
Reference Schmitt, 1992
Source of Information Roger Boerma

SOYBEAN CYST NEMATODE COLLEAGUE/CONTACT INFORMATION

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Page	149-154
REFERENCE	Noel92
Book/Journal	Biology and Management of the Soybean Cyst Nematode
Editors	R.D. Riggs and J. Allen Wrather
Author	G.R. Noel
Title	History, Distribution and Economics
Year	1992
Page	1-13
REFERENCE	Riggs92
Book/Journal	Biology and Management of the Soybean Cyst Nematode
Editors	R.D. Riggs and J. Allen Wrather
Author	R.D. Riggs
Title	Host Range
Year	1992
Page	107-114
REFERENCE	Sinclair&Backman89
Book/Journal	Compendium of Soybean Diseases
Editors	J.B. Sinclair and P.A. Backman
Authors	R.D. Riggs and D.P. Schmitt
Title	Soybean Cyst Nematode
Year	1989
Page	65-67
REFERENCE	Schmitt&Shannon92
Book/Journal	Crop Science
Authors	D.P. Schmitt and G. Shannon
Title	Differentiating soybean responses to H. glycines races
Volume	32
Year	1992
Page	275-277
REFERENCE	Hussey&Boerma92
R book	Biology and Management of the Soybean Cyst Nematode
Editors	R.D. Riggs and J. Allen Wrather
Authors	R.S. Hussey and H.R. Boerma
Title	Tolerance in Soybean
Year	1992
Page	169-181
REFERENCE	Noel,et al.90
Book/Journal	Methods for Evaluating Plant Species for Resistance to Plant-Parasitic Nematodes
R editor	J.L. Starr
Authors	G.R. Noel, J. Franco and P. Jatala
Title	Screening for Resistance to Cyst Nematodes, Globodera and Heterodera Species

Race : SCN 3
Differential value: Pickett: Resistant
Peking: Resistant
PI88788: Resistant
PI90763: Resistant
Contact: Anand
Resistance Gene: Rhg4
rhg1
rhg2
Source of Resistance: Peking
PI90763
PI437654
PI88788
Reference: Matson, 1965; Myers, 1991
Source of Information: Roger Boerma

Race : SCN 4
Differential value: Pickett: Susceptible
Peking: Susceptible
PI88788: Susceptible
PI90763: Susceptible
Contact: Anand
Source of Information: Roger Boerma

Race : SCN 5
Differential value: Pickett: Susceptible
Peking: Resistant
PI88788: Susceptible
PI90763: Resistant
Contact: Anand
Source of Resistance: Peking
PI90763
PI438489B
Reference: Anand, 1989; Myers, 1991
Source of Information: Roger Boerma

Race: SCN 6
Differential value: Pickett: Susceptible
Peking: Resistant
PI88788: Resistant
PI90763: Resistant
Contact: Riggs
Source of Information: Roger Boerma

Race: SCN 7
Differential value: Pickett: Resistant
Peking: Resistant
PI88788: Susceptible
PI90763: Susceptible
Source of Information: Roger Boerma

Race: SCN 8
Differential value: Pickett: Resistant
Peking: Resistant
PI88788: Resistant
PI90763: Susceptible
Source of Information: Roger Boerma

Race: SCN 9
Differential value: Pickett: Susceptible
Peking: Susceptible
PI88788: esistant
PI90763: Resistant
Contact: Riggs
Source of Information: Roger Boerma

Race: SCN 10
Differential value: Pickett: Susceptible
Peking: Resistant
PI88788: Resistant
PI90763: Susceptible
Source of Information: Roger Boerma

Race : SCN 11
Differential value: Pickett: Resistant
Peking: Susceptible
PI88788: Susceptible
PI90763: Resistant
Reference: Schmitt, 1992
Comment: Probably does not exist
Source of Information: Roger Boerma

Race : SCN 12

Differential value	Pickett	Resistant
	Peking	Susceptible
	PI88788	Resistant
	PI90763	Susceptible
Reference	Schmitt, 1992	
Source of Information	Roger Boerma	

Race : SCN 13

Differential value	Pickett	Resistant
	Peking	Susceptible
	PI88788	Resistant
	PI90763	Resistant
Reference	Schmitt, 1992	
Source of Information	Roger Boerma	

Race : SCN 14

Differential value	Pickett	Susceptible
	Peking	Susceptible
	PI88788	Resistant
	PI90763	Susceptible
Contact	Anand	
Source of Resistance	PI88788	

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SOYBEAN CYST NEMATODE REFERENCE INFORMATION

REFERENCE Riggs&Schmitt91
Book/Journal J. Nematol.
Authors R.D. Riggs and D.P. Schmitt
Title Optimization of the H. glycines race test procedure
Volume 23
Number 2
Year 1991

Year 1990
Page 24-32

REFERENCE Caldwell,et al.60
Journal Agron. J.
Authors B.E. Caldwell, C.A. Brim, and J.P. Ross
Title Inheritance of resistance to soybean cyst nematode
Volume 52
Year 1960
Page 635-636

REFERENCE Hartwig&Epps70
Journal Phytopathology
Authors E.E. Hartwig and J.M. Epps
Title An additional gene for resistance to soybean cyst nematode
Volume 60
Year 1970
Page 584

REFERENCE Matson&Williams65
Journal Crop Sci.
Authors A.L. Matson and L.F. Williams
Title Evidence of four genes for resistance to the soybean cyst nematode
Year 1965
Page 588-590

REFERENCE Thomas,et al.75
Journal Crop Sci.
Authors J.D. Thomas, C.E. Caviness, R.D. Riggs, and E.E. Hartwig
Title Inheritance of reaction to race 4 of soybean cyst nematode
Volume 15
Year 1975
Page 208-210

REFERENCE Anand&Rao-Arelli89
Journal Crop Sci.
Authors S.C. Anand and A.P. Rao-Arelli
Title Genetic analysis of soybean genotypes resistant to soybean cyst nematode race 5
Volume 29
Year 1989
Page 1181-1184

REFERENCE Riggs77
Journal J.Nematol.
Author R.D. Riggs
Title Worldwide distribution of soybean cyst nematode and its economic importance

Volume	9
Year	1977
Page	34-39
REFERENCE	Hancock,et al87
Journal	Crop Sci.
Authors	J.A. Hancock, F.G. Hancock, C.E. Caviness, R.D. Riggs
Title	Genetics of resistance in soybean to Race X of soybean cyst nematode
Volume	27
Year	1987
Page	704-707
REFERENCE	Myers&Anand91
Journal	Euphytica
Authors	G.O. Myers and S.C. Anand
Title	Inheritance of resistance and genetic relationships among soybean plant to races of soybean cyst nematode
Volume	55
Year	1991
Page	197-201
REFERENCE	Rao-Arelli etal.92
Book/Journal	Crop Sci.
Author	A.P. Rao-Arelli, S.C. Anand and J.A. Wrather
Title	Additional dominant gene in soybean conditioning resistance to soybean cyst nematode Race 3
Volume	32
Year	1992
Page	862-864

PHYTOPHTHORA GENERAL INFORMATION:

Pathology : Phytophthora
Organism_type Fungus
Genus_Species Phytophthora sojae
Authority Kaufmann
Gerdermann
Differentials : Phytophthora
Differential_Reaction R = resistant seedlings remain healthy

Differential_Reaction S = susceptible seedlings die within 7 days
Differntials Mukden
Sanga
Arksoy
CNS
PI171442
PI172901
PI86050
PI91160
Altona
PI340046
Harosoy
Std._Suscept._Germplasm Williams
Protocol 7-day greenhouse assay
Reference Kaufmann, 1958
IND90054339
Reference IND90054339
Kilen, 1992unpub
Wagner, 1992

Races Pmg_1 through Pmg_27
Reference Kaufmann, 1958
IND89041635
Hansen, 1991
Kilen, 1992 unpub
Wagner, 1992
Disease : Phytophthora root rot
Diagnostic_symptom stem and root rot : pre- and post-emergence damping-off:
chlorosis, wilt : dark brown discoloration of stem
Geographical_distr._(USA_&_Canada) most soybean-producing states, Ontari
Geographical_distr._(World) Australia, Asia, North America, Europ
Species_host_range soybean
Reference Hansen, 1991
IND89041635
Genus_host_range variety of diseases ranging from seedlings of annual vegetables to fully developed fruit & forest trees
Reference Agrios, 1978
Pathology_reactions : Phyto_Resistance
Resistance_type qualitative, vertical
Resistance_reaction R = resistant seedlings remain healthy
S = susceptible seedlings die within 7 days
Protocol 7-day greenhouse assay Reference IND90054339
7-day greenhouse assay Reference Kaufmann, 1958
cotyledon innoculation Reference IND79003478
taproot inoculation, aeroponics Reference Wagner, 199
Pathology_reactions : Phyto_Tolerance
Tolerance_Description Broad definition that includes root resistance, slow rotting,
or ability to endure infection. Tolerance may be masked b resistance. Quantitative, moderate to high heritability.
Reference IND84069544

IND91019781

Location Field
Protocol hill-plot evaluation over years
Tolerance_Rating Score 1 (no apparent root rot, very vigorous plants to
10 (all dead soon after emergence).
Reference IND84069543
Location Greenhouse
Protocol 28-day inoculum-layer test
Tolerance_Rating Score (1 to 100%) based on equation of# of live plants
& mean plant height of plants with & without Phytophthora.
Reference IND91019781
Location Laboratory
Protocol 22-day slant-board test
Tolerance_Rating mm of root rot at 7 days after inoculation
Reference IND85061334
Resistance_Locus Rps1
Rps2
Rps3
Rps4
Rps5
Rps6
Rps7
Source_of_Information Roger Boerma
Reviewed_By T.R. Anderson : Ontario, Canada
R.I Buzzell : Ontario, Canada
A.F. Schmitthenner : OH
J.R. Wilcox : IN
T.C. Kilen : MS

PHYTOPHTHORA RACE INFORMATION:

Race : Pmg_1
Differential_valuee Williams Susceptible
Mukden Resistant
Sanga Resistant
Arksoy Resistant
PI103091 Resistant
Kingwa Resistant
CNS Resistant
PI171442 Resistant
PI172901 Resistant
PI340046 Resistant
PI86050 Resistant
PI91160 Resistant
Altona Resistant
Harosoy Susceptible
Soybean_Resistance monogenic
Contact Schmitthenner
Resistance_Genee Rps1-a
Rps1-b
Rps1-c

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                Rps1-d
                Rps2-a
                Rps3-a
                Rps3-b
                Rps3-c
                Rps4-a
                Rps5-a
                Rps6-a
Reference       IND90054339
                IND91019781
Source_of_Information    Roger Boerma

Race : Pmg_2
Differential_valuee Williams       Susceptible
                Mukden    Resistant
                Sanga          Susceptible
                Arksoy         Resistant
                PI103091  Resistant
                Kingwa    Resistant
                CNS            Resistant
                PI171442       Resistant
                PI172901       Resistant
                PI340046       Resistant
                PI86050   Resistant
                PI91160   Resistant
                Altona         Resistant
                Harosoy   Susceptible
Soybean_Resistance  monogenic
Resistance_Genee        Rps1-a
                Rps1-c
                Rps1-d
                Rps1-k
                Rps3-a
                Rps3-b
                Rps3-c
                Rps4-a
                Rps5-a
                Rps6-a
Reference       IND90054339
                IND91019781
Source_of_Information    Roger Boerma

Race : Pmg_3
Differential_valuee Williams       Susceptible
                Mukden    Susceptible
                Sanga          Resistant
                Arksoy         Resistant
                PI103091       Resistant
                Kingwa    Resistant
                CNS            Resistant
                PI171442       Resistant
                PI172901       Resistant
                PI340046       Resistant
                PI86050   Resistant
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                PI91160    Resistant
                Altona          Resistant
                Harosoy    Susceptible
Soybean_Resistance  monogenic
Contact             Schmitthenner
Resistance_Gene          Rps1-b
                Rps1-c
                Rps1-d
                Rps1-k
                Rps2-a
                Rps3-a
                Rps3-b
                Rps3-c
                Rps4-a
                Rps5-a
Reference       IND90054339
                IND91019781
Source_of_Information    Roger Boerma

Race : Pmg_4
Differential_value  Williams       Susceptible
                Mukden     Susceptible
                Sanga           Resistant
                Arksoy          Susceptible
                PI103091        Resistant
                Kingwa          Resistant
                CNS             Resistant
                PI171442        Resistant
                PI172901        Resistant
                PI340046        Resistant
                PI86050    Resistant
                PI91160    Resistant
                Altona          Resistant
                Harosoy    Susceptible
Soybean_Resistance  monogenic
Contact             Schmitthenner
Resistance_Genee    Rps1-b
                Rps1-d
                Rps1-k
                Rps2-a
                Rps3-a
                Rps3-b
                Rps3-c
                Rps4-a
                Rps5-a
Reference       IND90054339
                IND91019781
Source_of_Information    Roger Boerma

Race : Pmg_5
Differential_value  Williams       Susceptible
                Mukden     Susceptible
                Sanga           Resistant
                Arksoy          Susceptible
```

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                PI103091        Resistant
                Kingwa    Resistant
                CNS             Resistant
                PI171442  Resistant
                PI172901        Resistant
                PI340046        Susceptible
                PI86050   Susceptible
                PI91160   Resistant
                Altona          Susceptible
                Harosoy   Susceptible
Soybean_Resistance  monogenic
Contact             Abney
Resistance_Gene           Rps1-b
                Rps1-d
                Rps1-k
                Rps2-a
                Rps3-a
                Rps3-b
Reference       IND90054339
                IND91019781
Source_of_Information     Roger Boerma
Race : Pmg_6
Differential_value  Williams        Susceptible
                Mukden    Susceptible
                Sanga           Resistant
                Arksoy          Resistant
                PI103091        Resistant
                Kingwa    Resistant
                CNS             Susceptible
                PI171442        Susceptible
                PI172901        Resistant
                PI340046        Susceptible
                PI86050   Susceptible
                PI91160   Susceptible
                Altona          Susceptible
                Harosoy   Susceptible
Soybean_Resistance  monogenic
Contact             Anderson
Resistance_Gene           Rps1-b
                Rps1-c
                Rps1-d
                Rps1-k
Reference       IND90054339
                IND91019781
Source_of_Information     Roger Boerma

Race : Pmg_7
Differential_value  Williams        Susceptible
                Mukden    Susceptible
                Sanga           Resistant
                Arksoy          Resistant
                PI103091        Resistant
                Kingwa    Resistant
                CNS             Susceptible
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                PI171442        Susceptible
                PI172901        Resistant
                PI340046  Susceptible
                PI86050   Susceptible
                PI91160   Susceptible
                Altona          Susceptible
                Harosoy   Susceptible
Soybean_Resistance  monogenic
Contact             Schmitthenner
Resistance_Gene           Rps1-b
                Rps1-c
                Rps1-d
                Rps1-k
Reference       IND90054339
                IND91019781
Source_of_Information     Roger Boerma

Race : Pmg_8
Differential_value  Williams        Susceptible
                Mukden    Susceptible
                Sanga           Resistant
                Arksoy          Resistant
                PI103091        Susceptible
                Kingwa    Resistant
                CNS             Susceptible
                PI171442        Resistant
                PI172901        Resistant
                PI340046        Susceptible
                PI86050   Susceptible
                PI91160   Resistant
                Altona          Susceptible
                Harosoy   Susceptible
Soybean_Resistance  monogenic
Contact             Abney
Resistance_Gene           Rps1-b
                Rps1-c
                Rps1-k
                Rps3-a
                Rps3-b
                Rps5-a
Reference       IND90054339
                IND91019781
                Kilen, 1992unpub
Source_of_Information     Roger Boerma

Race : Pmg_9
Differential_value  Williams        Susceptible
                Mukden    Susceptible
                Sanga           Resistant
                Arksoy          Resistant
                PI103091        Resistant
                Kingwa    Resistant
                CNS             Resistant
                PI171442        Resistant
```

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                PI172901        Resistant
                PI340046        Susceptible
                PI86050    Susceptible
                PI91160    Resistant
                Altona          Susceptible
                Harosoy    Susceptible
Soybean_Resistance  monogenic
Contact             Abney
Resistance_Gene           Rps1-b
                Rps1-c
                Rps1-d
                Rps1-k
                Rps2-a
                Rps3-a
                Rps3-b
Reference       IND90054339
                IND91019781
Source_of_Information     Roger Boerma

Race : Pmg_10
Differential_value  Williams        Susceptible
                Mukden     Resistant
                Sanga           Susceptible
                Arksoy          Resistant
                PI103091        Resistant
                Kingwa     Resistant
                CNS             Resistant
                PI171442        Susceptible
                PI172901        Resistant
                PI340046        Resistant
                PI86050    Resistant
                PI91160    Susceptible
                Altona          Resistant
                Harosoy    Susceptible
Soybean_Resistance  monogenic
Resistance_Gene           Rps1-a
                Rps1-c
                Rps1-d
                Rps1-k
                Rps2-a
                Rps3-b
                Rps3-c
                Rps4-a
Reference       IND90054339
                IND91019781
Source_of_Information     Roger Boerma

Race : Pmg_11
Differential_value  Williams        Susceptible
                Mukden     Resistant
                Sanga           Susceptible
                Arksoy          Resistant
                PI103091        Resistant
                Kingwa     Resistant
```

	CNS	Resistant
	PI171442	Resistant
	PI172901	Resistant
	PI340046	Resistant
	PI86050	Susceptible
	PI91160	Resistant
	Altona	Susceptible
	Harosoy	Susceptible
Soybean_Resistance	monogenic	
Resistance_Gene	Rps1-a	
	Rps1-c	
	Rps1-d	
	Rps1-k	
	Rps2-a	
	Rps3-a	
	Rps3-b	
	Rps3-c	
Reference	IND90054339	
	IND91019781	
Source_of_Information	Roger Boerma	

Race : Pmg_12

Differential_value	Williams	Susceptible
	Mukden	Susceptible
	Sanga	Susceptible
	Arksoy	Susceptible
	PI103091	Susceptible
	Kingwa	Susceptible
	CNS	Resistant
	PI171442	Susceptible
	PI172901	Susceptible
	PI340046	?
	PI86050	Resistant
	PI91160	R needs verification
	Altona	Resistant
	Harosoy	Resistant
Soybean_Resistance	monogenic	
Resistance_Gene	Rps2-a	
	Rps4-a	
	Rps5-a	
	Rps6-a	
Reference	IND90054339	
	IND91019781	
Source_of_Information	Roger Boerma	

Race : Pmg_13

Differential_value	Williams	?
	Mukden	Resistant
	Sanga	Resistant
	Arksoy	Resistant
	PI103091	Resistant
	Kingwa	Resistant
	CNS	Resistant
	PI171442	Resistant

```
                PI172901        Resistant
                PI340046        Resistant
                PI86050    Resistant
                PI91160    Resistant
                Altona          Susceptible
                Harosoy    Susceptible
Soybean_Resistance  monogenic
Contact             Abney
Resistance_Gene           Rps1-a
                Rps1-b
                Rps1-c
                Rps1-d
                Rps1-k
                Rps2-a
                Rps3-a
                Rps3-b
                Rps3-c
                Rps4-a
Reference       IND90054339
Reference       IND91019781
Source_of_Information     Roger Boerma
Race : Pmg_14
Differential_value  Williams  ?
                Mukden     Susceptible
                Sanga           Resistant
                Arksoy          Susceptible
                PI103091        Resistant
                Kingwa     Resistant
                CNS             Resistant
                PI171442        Resistant
                PI172901        Resistant
                PI340046        Resistant
                PI86050    Resistant
                PI91160    Resistant
                Altona          Resistant
                Harosoy    Susceptible
Soybean_Resistance  monogenic
Resistance_Gene           Rps1-c
                Rps1-d
                Rps1-k
                Rps2-a
                Rps3-a
                Rps3-b
                Rps3-c
                Rps4-a
                Rps5-a
Reference       IND90054339
                IND91019781
Source_of_Information     Roger Boerma

Race : Pmg_15
Differential_value  Williams  ?
                Mukden     Resistant
                Sanga           Resistant
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                Arksoy          Resistant
                PI103091        Resistant
                Kingwa      Resistant
                CNS             Resistant
                PI171442        Susceptible
                PI172901        Resistant
                PI340046        Resistant
                PI86050     Resistant
                PI91160     Susceptible
                Altona          Resistant
                Harosoy     Susceptible
Soybean_Resistance  monogenic
Resistance_Gene         Rps1-a
                Rps1-b
                Rps1-c
                Rps1-d
                Rps1-k
                Rps3-b
                Rps3-c
                Rps4-a
Reference       IND90054339
                IND91019781
Source_of_Information   Roger Boerma

Race : Pmg_16
Differential_value  Williams        Susceptible
                Mukden      Resistant
                Sanga           Susceptible
                Arksoy          Susceptible
                PI103091        Resistant
                Kingwa      Susceptible
                CNS             Resistant
                PI171442        Resistant
                PI172901    R needs verification
                PI340046    ?
                PI86050     Resistant
                PI91160     S (needs verification)
                Altona          Resistant
                Harosoy     Resistant
Soybean_Resistance  monogenic
Contact             Schmitthenner
Resistance_Gene         Rps1-a
                Rps1-d
                Rps2-a
                Rps3-a
                Rps3-b(?)
                Rps4-a
                Rps6-a
Reference       IND90054339
                IND91019781
Source_of_Information   Roger Boerma

Race : Pmg_17
Differential_value  Williams  ?
```

```
                Mukden    Resistant
                Sanga          Susceptible
                Arksoy         Resistant
                PI103091       Susceptible
                Kingwa    Resistant
                CNS            Resistant
                PI171442       Susceptible
                PI172901       Susceptible
                PI340046       Susceptible
                PI86050   Susceptible
                PI91160   Susceptible
                Altona         Susceptible
                Harosoy   Susceptible
Soybean_Resistance  monogenic
Resistance_Gene           Rps1-a
                Rps1-b (needs verification)
                Rps1-c
                Rps1-k
Reference       IND90054339
                IND91019781
                Kilen92unpub
Source_of_Information     Roger Boerma

Race : Pmg_18
Differential_value  Williams       Susceptible
                Mukden    Resistant
                Sanga          Resistant
                Arksoy         Susceptible
                PI103091       Resistant
                Kingwa    Resistant
                CNS            Resistant
                PI171442  Resistant
                PI172901       Susceptible
                PI340046  ?
                PI86050   Resistant
                PI91160   Resistant, needs verification
                Altona         Resistant
                Harosoy   Resistant
Soybean_Resistance  monogenic
Contact
Resistance_Gene           Rps1-a
                Rps1-b
                Rps1-d
                Rps1-k
                Rps2-a
                Rps3-a
                Rps4-a
                Rps5-a(?)
                Rps6-a
Reference       IND90054339
                IND91019781
Source_of_Information     Roger Boerma

Race : Pmg_19
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```
Differential_valu        Williams       Susceptible
                Mukden   Susceptible
                Sanga          Susceptible
                Arksoy         Susceptible
                PI103091       Susceptible
                Kingwa   Susceptible
                CNS            Resistant
                PI171442       Susceptible
                PI172901       Susceptible
                PI340046 ?
                PI86050  Resistant
                PI91160  Susceptible
                Altona         Resistant
                Harosoy  Resistant
Soybean_Resistance  monogenic
Resistance_Gene          Rps2-a
                Rps4-a
                Rps6-a
Reference       IND90054339
                IND91019781
Source_of_Information    Roger Boerma

Race : Pmg_20
Differential_value  Williams       Susceptible
                Mukden   Susceptible
                Sanga          Susceptible
                Arksoy         Susceptible
                PI103091       Resistant
                Kingwa   Susceptible
                CNS            Resistant
                PI171442       Susceptible
                PI172901 ?
                PI340046 ?
                PI86050  Resistant
                PI91160  Resistant, needs verification
                Altona         Resistant
                Harosoy  Susceptible
Soybean_Resistance  monogenic
Resistance_Gene          Rps1-d
                Rps2-a
                Rps4-a
Reference       IND90054339
                IND91019781
Source_of_Information    Roger Boerma

Race : Pmg_21
Differential_value  Williams  ?
                Mukden   Susceptible
                Sanga          Resistant
                Arksoy         Resistant
                PI103091       Resistant
                Kingwa   Resistant
                CNS      ?
                PI171442       Susceptible
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```
                PI172901  Resistant
                PI340046       Resistant
                PI86050   Resistant
                PI91160   Susceptible
                Altona         Resistant
                Harosoy   Susceptible
Soybean_Resistance  monogenic
Contact             Abney
Resistance_Gene           Rps1-b
                Rps1-c
                Rps1-d
                Rps1-k
                Rps3-b
                Rps3-c
                Rps4-a
Reference       IND90054339
                IND91019781
Source_of_Information     Roger Boerma
Race : Pmg_22
Differential_value  Williams  ?
                Mukden    Susceptible
                Sanga          Resistant
                Arksoy         Susceptible
                PI103091       Resistant
                Kingwa    Resistant
                CNS       ?
                PI171442       Susceptible
                PI172901       Resistant
                PI340046       Resistant
                PI86050   Susceptible
                PI91160   Susceptible
                Altona         Susceptible
                Harosoy   Susceptible
Soybean_Resistance  monogenic
Contact             Abney
Resistance_Gene           Rps1-b
                Rps1-d
                Rps1-k
                Rps3-b
Reference       IND90054339
                IND91019781
Source_of_Information     Roger Boerma

Race : Pmg_23
Differential_value  Williams  ?
                Mukden    Susceptible
                Sanga          Susceptible
                Arksoy         Resistant
                PI103091       Resistant
                Kingwa         ?
                CNS       ?
                PI171442       Resistant
                PI172901  ?
                PI340046  ?
```

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                PI86050    ?
                PI91160    ?
                Altona          Susceptible
                Harosoy    Susceptible
Soybean_Resistance  monogenic
Resistance_Gene         Rps1-c
                Rps1-d
Reference       IND90054339
                IND91019781
Source_of_Information    Roger Boerma
Race : Pmg_24
Differential_value  Williams  ?
                Mukden     Resistant
                Sanga           Susceptible
                Arksoy          Resistant
                PI103091        Resistant
                Kingwa     Resistant
                CNS        ?
                PI171442        Susceptible
                PI172901        Resistant
                PI340046        Resistant
                PI86050    Susceptible
                PI91160    Susceptible
                Altona          Susceptible
                Harosoy    ?
Soybean_Resistance  monogenic
Resistance_Gene         Rps1-a
                Rps1-c
                Rps1-d
                Rps1-k
                Rps3-b
Reference       IND90054339
                IND91019781
Source_of_Information    Roger Boerma
Race : Pmg_25
Differential_value  Williams  ?
                Mukden     Susceptible
                Sanga           Susceptible
                Arksoy          Susceptible
                PI103091        Resistant
                Kingwa     Susceptible
                CNS        ?
                PI171442        Resistant
                PI172901        Resistant
                PI340046        Resistant
                PI86050    Resistant
                PI91160    Resistant
                Altona          Resistant
                Harosoy    ?
Soybean_Resistance  monogenic
Contact             Abney
Resistance_Gene     Rps1-d
                Rps3-a
                Rps3-b
```

```
                Rps3-c
                Rps4-a
                Rps5-a
Reference       IND90054339
                IND91019781
Source_of_Information    Roger Boerma

Race : Pmg_26
Differential_value  Williams  ?
                Mukden    Resistant
                Sanga          Susceptible
                Arksoy         Resistant
                PI103091  ?
                Kingwa         Resistant
                CNS       ?
                PI171442       Susceptible
                PI172901  ?
                PI340046  ?
                PI86050   Susceptible
                PI91160   Susceptible
                Altona         Susceptible
                Harosoy   ?
Soybean_Resistance  monogenic
Resistance_Gene          Rps1-a
                Rps1-c
Source_of_Information    Roger Boerma

Race : Pmg_27
Differential_value  Williams       Susceptible
                Mukden    Resistant
                Sanga          Susceptible
                Arksoy         Susceptible
                PI103091       Resistant
                Kingwa    Susceptible
                CNS       Resistant
                PI171442       Susceptible
                PI172901  ?
                PI340046  ?
                PI86050   Susceptible
                PI91160   ?
                Altona         Susceptible
                Harosoy   Susceptible
Soybean_Resistance  monogenic
Resistance_Gene          Rps1-a
Reference       Kilen92unpub
Source_of_Information    Roger Boerma


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PHYTOPHTHORA REFERENCE INFORMATION

REFERENCE Walker&Schmitthenner84c
Journal Crop Sci.
Authors A.K. Walker and A.F. Schmitthenner
Title Comparison of field and greenhouse evaluations for tolerance to phytophthora rot in soybean
Volume 24
Year 1984
Page 487-489

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Journal Crop Sci.
Authors A.K. Walker and A.F. Schmitthenner
Title Heritability of tolerance to phytophthora rot in soybean
Volume 24
Year 1984
Page 490-491

REFERENCE McBlain&Schmitthenner91
Journal Ohio Research Bulletin
Authors B.A. McBlain & A.F. Schmitthenner
Title Evaluations of recurrent selection for Phytophthora tolerance
Number 1187
Year 1991

REFERENCE Agrios78
Book Plant Pathology, 2nd ed.
R author G.N. Agrios
R publisher Academic Press, Inc.
Year 1978
Page 213-235

REFERENCE Palmer&Kilen87
Book Soybeans:Improvement, Production & Uses
Editor J.R. Wilcox
Authors R.G. Palmer & T.C. Kilen
Title Qualitative Genetics & Cytogenetics
Year 1987
Page 135-209

REFERENCE Kaufmann&Gerdemann58
Journal Phytopathology
Authors M.J. Kaufmann & J.W. Gerdemann
Title Root and stem rot of soybean caused by Phytophthora sojae N. sp.
Volume 48
Year 1958
Page 201-208

REFERENCE Ward90
Book Biological Control of Soil-borne Plant Pathogens
Editor D. Hornby
R author E.W.B. Ward
Title The interaction of soya beans with Phytophthora megasperma f.sp. glycinea: Pathogenicity
Year 1990
Page 311-327

REFERENCE Kilen92unpub
Journal

Authors T.C. Kilen
Title Unpublished report presented at the 1992 Soybean Breeders/Pathologists Workshop in St. Louis, MO.
Volume
Year 1992
Page

REFERENCE McBlain etal91
Journal Crop Sci.
Authors B.A. McBlain, J.K. Hacker, M.M. Zimmerly and A.F. Schmitthenner
Title Tolerance to Phytophthora Rot in Soybean: II. Evaluation of Three Tolerance Screening Methods
Volume 31
Year 1991
Page 1412-1417

REFERENCE Olah&Schmitthenner85
Journal Phytopath.
Authors A.F. Olah & A.F. Schmitthenner
Title A growth chamber test for measuring phytophthora root rot tolerance in soybean seedlings
Volume 75
Year 1985
Page 546-548

REFERENCE Anderson&Buzzell92
Journal Plant Dis.
Authors T.R. Anderson & R.I. Buzzell
Title Inheritance and linkage of the Rps7 gene for resistance to phytophthora rot of soybean
Volume 76
Year 1992
Page 958-959

REFERENCE Buzzell&Anderson92
Journal Plant Dis.
Authors R.I. Buzzell and T.R. Anderson
Title Inheritance and race reaction of a new soybean Rps1 allele
Volume 76
Year 1992
Page 600-601

REFERENCE Athow&Laviolette82
Journal Phytopath.
Authors K.L. Athow & F.A. Laviolette
Title Rps6, a major gene for resistance to

	Phytophthora megasperma f.sp. glycinea in soybean
Volume	72
Year	1982
Page	1564-1567

REFERENCE	Athow etal.80
Journal	Phytopath.
Authors	K.L. Athow, E.H. Mueller, J.R. Wilcox
Title	A new major gene for resistance to Phytophthora megasperma var. sojae in soybean
Volume	70
Year	1980
Page	977-980

REFERENCE	Bernard&Cremeens81
Journal	Soybean Genet. Newsl.
Authors	R.L. Bernard & C.R. Cremeens
Title	An allele at the rps locus from the variety 'Kingwa'
Volume	8
Year	1981
Page	40-42

REFERENCE	Bernard&Weiss73
Book	Soybeans: Improvement, production and uses
Editor	B.E. Caldwell
Authors	R.L. Bernard & M.G. Weiss
Title	Qualitative genetics
Volume	Agronomy 16
Year	1973
Page	117-154

REFERENCE	Buzzell&Anderson81
Journal	Soybean Genet. Newsl.
Authors	R.I. Buzzell & T.R. Anderson
Title	Another major gene for resistance to Phytophthora megasperma var. sojae in soybeans
Volume	8
Year	1981
Page	30-33

REFERENCE	Kilen etal74
Journal	Crop Sci.
Authors	T.C. Kilen, E.E. Hartwig & B.L. Keeling
Title	Inheritance of a second major gene for resistance to phytophthora rot in soybeans
Volume	14
Year	1974
Page	260-262

REFERENCE Mueller etal78
Journal Phytopath.
Authors E.H. Mueller, K.L. Athow, & F.A. Laviolette
Title Inheritance to four physiologic races of Phytophthora megasperma var. sojae
Volume 68
Year 1978
Page 1318-1322

REFERENCE Wagner&Wilkinson92
Journal Plant Dis.
Authors R. E. Wagner & H. T. Wilkinson
Title A new physiological race of Phytophtora sojae on soybean.
Volume 76
Year 1992
Page 212

REFERENCE Ploper, etal85
Journal Phytopathology
Authors L. D. Ploper, K. L. Athow, & L. A. Laviolette
Title A new allele at the Rps3 locus for resistance to Phytophthora megasperma f. sp. glycinea in soybean.
Volume 75
Year 1985
Page 690-694

REFERENCE Athow, etal86
Journal Soybean Genetic Newsletter
Authors K. L. Athow, F. A. Laviolette, A. C. Layton Hahn, & L. D. Ploper
Title Genes for resistance to Phytophthora megasperma f. sp. glycinea in PI273483D, PI64747, PI274212, PI82312N, and PI340046.
Volume 13
Year 1986
Page 119-131

REFERENCE Rennie&Beversdorf87
Journal Soybean Genetics Newsletter
Authors B. D. Rennie & W. D. Beversdorf
Title On the response of the Rps1-b allele to race 17 of Phytophthora megasperma f. sp. glycinea.
Volume 14
Year 1987

Page	82-84
REFERENCE	Faris, etal89
Journal	Can. J. Bot.
Authors	M. A. Faris, F. E. Sabo, D. J. S. Barr, & C. S. Lin
Title	The systematics of Phytophthora sojae and P. megasperma.
Volume	67
Year	1989
Page	1442-1447
REFERENCE	Hansen&Maxwell91
Journal	Mycologia
Authors	E. M. Hansen & D. P. Maxwell
Title	Species of the Phytophthora megasperma complex.
Volume	83
Year	1991
Page	376-381
REFERENCE	Morrison&Thorne78
Journal	Crop Sci.
Authors	R. H. Morrison & J. C. Thorne
Title	Inoculation of detached cotyledons for screening soybeans against two races of Phytophthora megasperma f. sp. sojae.
Volume	18
Year	1978
Page	1089-1091
REFERENCE	Wagner&Wilkinson92
Journal	Plant Dis.
Authors	R. E. Wagner & H. T. Wilkinson
Title	An aeroponics system for investigating disease development on soybean taproots infected with Phytophthora sojae.
Volume	76
Year	1992
Page	610-614

SOYBEAN MOSAIC VIRUS GENERAL INFORMATION

```
Pathology : Soybean Mosaic Virus
Organism_type   Virus
Virus_group     Potyvirus
Differentials   Soybean Mosaic Virus
     Differential_Reaction     Symtomless
                    Necrotic
                    Mosaic
                    Not_tested
     Differentials        Davis
                    York
                    Marshall
                    Ogden
                    Kwanggyo
                    Buffalo
                    PI96983
                    Suweon 97
                    PI486355
     Standard_Sus.Germplasm    Clark
     Protocol             30 Day Greenhouse Assay
     Reference Cho, 1979
     Reference Buss, 1989
Strain_groups   SMV_G1  SMV_G2  SMV_G3  SMV_G4
          SMV_G5  SMV_G6  SMV_G7  SMV_G14
Reference  Buss, 1989
Disease    Soybean Mosaic Virus
     Diagnostic_symptom   Leaves are stunted, mottled, rugose,
                    with yellowish vein clearing and dark
                    green enations along veins or brown
                    discoloration of leaf veins.  Yellowing
                    and defined systemic necrotic lesions.
                    Plants are stunted with shortened petioles
                    and internodes or browning of petioles and
                    stems, but blight, defoliation, and plant
                    death.  Seeds are mottled and small in size.
     Geographical_distr.  All major soybean growing areas
     Species_host_range   Soybean
     Family_host_range    Most host species belong to Leguminosae

     Reference       Demski, 1989

Soybean_Defense                SMV_Resistance
     Resistance_type           qualitative; vertical
     Resistance_reaction  Resistant = symptomless or necrotic
                    Susceptible = Mosiac
     Protocol            30-day greenhouse
                    field
     Reference       Chen, 1991
Resistance_Locus         Rsv1
                    Rsv2
                    Rsv3
```

SOYBEAN MOSAIC VIRUS STRAIN GROUP INFORMATION

```
Strain Group : SMV_G1
Differential_value   Clark          Mosaic
Differential_value   Davis          Symptomless
Differential_value   York           Symptomless
Differential_value   Marshall       Symptomless
Differential_value   Ogden          Symptomless
Differential_value   Kwanggyo       Symptomless
Differential_value   Buffalo        Symptomless
Differential_value   PI96983  Symptomless
Differential_value   Suweon 97      Symptomless
Differential_value   PI486355       Symptomless
Soybean_Resistance   Monogenic
Contact              American Type Culture Collection
Resistance_Gene           rsv1-y
Resistance_Gene           rsv1-m
Resistance_Gene           rsv1-k
Reference       Bowers, 1992
Source_of_Information     Roger Boerma

Strain Group : SMV_G2
Differential_value   Clark          Mosaic
Differential_value   Davis          Symptomless
Differential_value   York           Symptomless
Differential_value   Marshall       Necrotic
Differential_value   Ogden          Symptomless
Differential_value   Kwanggyo       Symptomless
Differential_value   Buffalo        Symptomless
Differential_value   PI96983  Symptomless
Differential_value   Suweon 97      Symptomless
Differential_value   PI486355       Symptomless
Soybean_Resistance   Monogenic
Contact              American Type Culture Collection
Resistance_Gene           Rsv1
Resistance_Gene           rsv1-t
Reference       Bowers, 1992
Source_of_Information     Roger Boerma

Strain Group : SMV_G3
Differential_value   Clark          Mosaic
Differential_value   Davis          Symptomless
Differential_value   York           Symptomless
Differential_value   Marshall       Necrotic
Differential_value   Ogden          Necrotic
Differential_value   Kwanggyo       Symptomless
Differential_value   Buffalo        Symptomless
Differential_value   PI96983  Symptomless
Differential_value   Suweon 97      Symptomless
Differential_value   PI486355       Symptomless
Soybean_Resistance   Monogenic
Contact              American Type Culture Collection
Resistance_Gene           Rsv1
Resistance_Gene           rsv1-t
Reference       Bowers, 1992
Comment              rsv1-t = necrosis
```

Source_of_Information Roger Boerma

Strain Group : SMV_G4

Differential_value	Clark	Mosaic
Differential_value	Davis	Necrotic
Differential_value	York	Symptomless
Differential_value	Marshall	Symptomless
Differential_value	Ogden	Symptomless
Differential_value	Kwanggyo	Symptomless
Differential_value	Buffalo	Symptomless
Differential_value	PI96983	Symptomless
Differential_value	Suweon 97	Symptomless
Differential_value	PI486355	Symptomless
Contact	American Type Culture Collection	
Source_of_Information	Roger Boerma	

Strain Group : SMV_G5

Differential_value	Clark	Mosaic
Differential_value	Davis	Mosaic
Differential_value	York	Mosaic
Differential_value	Marshall	Symptomless
Differential_value	Ogden	Symptomless
Differential_value	Kwanggyo	Necrotic
Differential_value	Buffalo	Symptomless
Differential_value	PI96983	Symptomless
Differential_value	Suweon 97	Symptomless
Differential_value	PI486355	Symptomless
Contact	American Type Culture Collection	
Source_of_Information	Roger Boerma	

Strain Group : SMV_G6

Differential_value	Clark	Mosaic
Differential_value	Davis	Mosaic
Differential_value	York	Mosaic
Differential_value	Marshall	Necrotic
Differential_value	Ogden	Symptomless
Differential_value	Kwanggyo	Necrotic
Differential_value	Buffalo	Symptomless
Differential_value	PI96983	Symptomless
Differential_value	Suweon 97	Symptomless
Differential_value	PI486355	Symptomless
Contact	American Type Culture Collection	
Reference	Bowers, 1992	
Comment	necrosis in PI96983	
Source_of_Information	Roger Boerma	

Strain Group : SMV_G7

Differential_value	Clark	Mosaic
Differential_value	Davis	Mosaic
Differential_value	York	Mosaic
Differential_value	Marshall	Necrotic
Differential_value	Ogden	Necrotic
Differential_value	Kwanggyo	Necrotic

Differential_value	Buffalo	Necrotic
Differential_value	PI96983	Necrotic
Differential_value	Suweon 97	Symptomless
Differential_value	PI486355	Symptomless
Contact	American Type Culture Collection	
Source_of_Information	Roger Boerma	

Strain Group : SMV_G14		
Differential_value	Clark	Not_tested
Differential_value	Davis	Not_tested
Differential_value	York	Not_tested
Differential_value	Marshall	Not_tested
Differential_value	Ogden	Not_tested
Differential_value	Kwanggyo	Not_tested
Differential_value	Buffalo	Symptomless
Differential_value	PI96983	Symptomless
Differential_value	Suweon 97	Necrotic
Differential_value	PI486355	Symptomless
Source_of_Information	Roger Boerma	

SOYBEAN MOSAIC VIRUS COLLEAGUE/CONTACT INFORMATION

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Fax	301-231-5826

SOYBEAN MOSAIC VIRUS REFERENCE INFORMATION

Not Available at this time.

[Annex IV follows]

Working Paper on Test Guidelines

For

Subterranean Clover

Trifolium subterraneum, including ssp. *subterraneum*, ssp. *yanninicum* and ssp. *brachycalycinum*

Prepared by Australia with the assistance of the Western Australian Department of Agriculture

November 1993

TABLE OF CONTENTS

I. Subject of these Guidelines

These Test Guidelines apply to all varieties of *Trifolium subterraneum*, including ssp. *subterraneum*, ssp. *yanninicum* and ssp. *brachycalycinum*.

II Material Required

1. The competent authorities decide when, where and in what quantity and quality the seed required for testing the variety is to be delivered. Applicants submitting material from a State other than that in which the testing takes place must make sure that all customs formalities are complied with. As a minimum, for each year of testing, the following quantity of seed is recommended:

5 grams

2. The seed must not have undergone any treatment unless the competent authorities allow or request such treatment. If it has been treated, full details of the treatment must be given.

III Conduct of Tests

1. The minimum duration of tests should be two similar growing periods.

2. The tests should normally be conducted at one place. If any important characteristics of the variety cannot be seen at that place, the variety may be tested at an additional place.

3. The field tests should be carried out under conditions ensuring normal growth. The size of the plots should be such that plants or parts of plants may be removed for measurement and counting without prejudice to the observations which must be made up to the end of the growing period. As a minimum, each test should include a total of 30 spaced plants and may in addition include 4 metres of row. Separate plots for observation and for measuring can only be used if they have been subject to similar environmental conditions.

4. Plots with spaced plants. Each test should consist of 30 single spaced plants per variety arranged in 2, 3 or 5 replicates, i.e. plots of 15, 10 or 6 plants. More replicates are generally more efficient when fewer varieties are included in the test.

5. Row plots. Each test which includes row plots should consist of at least 4 metres of row arranged in two replicates, each of 2 metres. The size of the plots should be such that plants or parts of plants may be removed for observation without prejudice to the visual assessments which must be made up to the end of the growing period. The density of seed should be 1.0 gram per metre, resulting in approximately 150 plants per metre.

6. Additional tests for special purposes may be established.

IV Methods and Observations

1. All observations determined by measurement or counting should be made on 20 plants or parts of 20 plants.

2. Unless indicated otherwise, observations on the leaf and flower should be made between the fourth true leaf stage and the onset of flowering. Observations on the burr and seed should be made on fully mature, senesced plants.

V Grouping of Varieties

1. Characteristics which are suitable for grouping purposes are those which are known from experience not to vary, or to vary only slightly, within a variety and which in their various states are fairly evenly distributed within the collection.

2. In the first place, the collection should be divided according to the subspecies:

ssp. *subterraneum;*
ssp. *yanninicum;* and
ssp. *brachycalycinum.*

3. It is recommended that the competent authorities then use the following characteristics for grouping varieties:

(i)	leaf: pattern of mark	(characteristic 8)
(ii)	isoflavones: level of formononetin	(characteristic 23)
(iii)	stipule: anthocyanin colouration	(characteristic 26)
(iv)	time to commencement of flowering	(characteristic 27)
(v)	calyx: area of pigmentation	(characteristic 29)
(vi)	runner hairiness	(characteristic 32)
(vii)	seed: rate of hardseed breakdown	(characteristic 40)

VI Characteristic and Symbols

1. To assess distinctness, homogeneity and stability, the characteristics and their states as given in the three UPOV working languages in the Table of Characteristics should be used.

2. Notes (1 to 9), for the purposes of electronic data processing, are given opposite the states of the different characteristics.

3. Legend:

(*) Characteristics that should be used every growing period for the examinations of all varieties and should always be included in the

description of the variety, except when the state of expression of a preceding characteristic or regional environmental conditions render this impossible.

(+) See Explanations of the Table of Characteristics in Chapter VIII.

VII Table of Characteristics

	Characteristics	English	Example varieties	Note
1	Leaf: hairiness of petiole	absent	'Denmark', 'Larisa'	1
		very weak		2
		weak	'Clare'	3
		weak to medium		4
		medium	'Dalkeith', 'Esperance'	5
		medium to strong		6
		strong	'Bacchus Marsh'	7
		strong to very strong		8
		very strong		9
2	Leaf: attitude of petiole hairs	erect	'Mt. Barker'	3
		semi-appressed	'Dalkeith'	5
		appressed		7
3	Terminal leaflet: length	short		3
		medium		5
		long		7
4	Terminal leaflet: width	narrow		3
		medium		5
		broad		7
5	Leaflet: length/width ratio	much broader than long		1
		broader than long		3
		as long as broad		5
		longer than broad		7
		much longer than broad		9
		ratio of length/width:		

6	Leaflet: shape	triangular	'Geraldton', 'Yarloop'	1
		intermediate	'Seaton Park'	2
		rounded	'Northam', 'Meteora'	3
7	Leaflet: colour	light green		3
		light to medium green		4
		medium green		5
		medium to dark green		6
		dark green	'Dalkeith', 'Leura'	7
(*) 8 (+)	Leaflet: pattern of mark	absent	'Uniwager'	1
		a pair of arms only (types A1 to A3)	'Yarloop'	2
		a single transverse band only (types B1 and B2)	'Nungarin'	3
		a single, crescent-shaped, central mark only (types C1 to C4)	'Mt Barker'	4
		arms and a crescent (types A1 to A3 with C1 to C4)	'Seaton Park'	5
9 (+)	Varieties with arms: Type of arms	absent	'Uniwager', 'Mt Barker'	1
		absent to A1	'Dinninup'	2
		A1	'Yarloop'	3
		A1 to A2	'Trikkala', 'Dalkeith'	4
		A2	'Nuba', 'Seaton Park'	5
		A2 to A3	'Karridale'	6
		A3		7
10	Varieties with arms: Colour of arms	faint green	'Denmark'	1
		light green	'Nuba', 'Woogenellup'	2
		white	'Seaton Park'	3
		cream	'Karridale'	4
		brown		5
		purple		6
		red		7

11 (+)	Varieties with bands only: Width of transverse band	absent	'Uniwager', 'Mt Barker', 'Yarloop'	1
		absent to B1		2
		B1	'Northam', 'Geraldton'	3
		B1 to B2		4
		B2	'Nungarin'	5
		wider than B2		6
12	Varieties with bands only: Colour of transverse band	faint green		1
		pale green	'Nungarin', 'Geraldton', 'Northam'	2
		white		3
		cream		4
		brown		5
		purple		6
		red		
13	Varieties with bands only: position of transverse band	towards base		3
		central	'Nungarin', 'Northam', 'Geraldton'	5
		towards apex		7
14 (+)	Varieties with a crescent: Type of central crescent-shaped mark	absent	'Uniwager', 'Yarloop'	1
		absent to C1		2
		C1	'Daliak'	3
		C1 to C2		4
		C2	'Junee', 'Dalkeith'	5
		C2 to C3		6
		C3	'Mt Barker'	7
		C3 to C4		8
		C4	'Meteora'	9
15	Varieties with a crescent: Colour of central crescent-shaped mark	faint green	'Nuba'	1
		light green	'Mt Barker'	2
		white		3
		cream		4
		brown		5
		purple		6
		red		7
16	Leaflet: indentation of distal margin	absent or very weak	'Dwalganup'	1
		weak		3
		medium	'Seaton Park', 'Dalkeith'	5
		strong		7
		very strong	'Woogenellup'	9

17	Leaflet: tendency to flecking with anthocyanin	absent	'Seaton Park'	1
		very weak	'Junee'	2
		weak	'Dalkeith', 'Woogenellup'	3
		weak to medium	'Daliak'	4
		medium	'Mt Barker'	5
		medium to strong	'Bacchus Marsh'	6
		strong		7
18	Leaflet: tendency to flush with anthocyanin	absent	'Denmark', 'Dalkeith'	1
		very weak	'Leura', 'Enfield'	2
		weak	'Nungarin'	3
		weak to medium	'Geraldton'	4
		medium	'Dinninup', 'Dwalganup'	5
		medium to strong		6
		strong	'Clare'	7
19	Leaflet: flush colour	brown		1
		purplish brown		2
		brownish purple		3
		purple		4
		red		5
		purplish red		6
		reddish purple		7
		pinkish brown		8
		reddish brown		9
		RHS Chart No.		
20	Leaflet: location of flush	between distal margin and crescent		1
		around the crescent		2
		along midrib	'Yarloop'	3
		midrib and crescent	'Dinninup'	4
		between crescent and base	'Clare'	5
		nearest to base		6

21	Leaflet: hairiness of upper surface	absent	'Clare''Dinninup''Larisa'	1
		very weak	'Enfield', 'Green Range'	2
		weak	'Denmark'	3
		weak to medium		4
		medium	'Bacchus Marsh', 'Dalkeith'	5
		medium to strong		6
		strong	'Esperance', 'Northam'	7
		strong to very strong		8
		very strong		9
22	Leaflet: attitude of upper surface hairs	erect	'Mt Barker'	3
		semi-appressed	'Daliak', 'Dalkeith'	5
		appressed		7
(*) 23	Isoflavones: level of formononetin in leaves before the onset of flowering (percentage dry matter) Reference: Francis and Millington (1965)	less than 0.1%	'Dalkeith', 'Denmark'	1
		0.1% to < 0.2%	'Trikkala'	2
		0.2% to < 0.4%	'Enfield'	3
		0.4% to < 0.6%	'Meteora'	4
		0.6% to < 1.0%	'Geraldton'	5
		1.0% to < 1.5%	'Dwalganup'	6
		1.5% to < 2.0%	'Yarloop', Dinninup'	7
		2.0% and over		8
24	Isoflavones: level of genistein in leaves before the onset of flowering (percentage dry matter) Reference: Francis and Millington (1965)	less than 0.1%	'Uniwager'	1
		0.1% to < 0.2%	-	2
		0.2% to < 0.4%	'Mt Barker'	3
		0.4% to < 0.6%	'Dalkeith'	4
		0.6% to < 1.0%	'Esperance'	5
		1.0% to < 1.5%	'Leura'	6
		1.5% to < 2.0%	'Gosse'	7
		2.0% and over	'Nuba'	8
25	Isoflavones: level of biochanin A in leaves before the onset of flowering (percentage dry matter) Reference: Francis and Millington (1965)	less than 0.1%	'Dalkeith'	1
		0.1% to < 0.2%	'Clare'	2
		0.2% to < 0.4%	'Yarloop'	3
		0.4% to < 0.6%	'Leura'	4
		0.6% to < 1.0%	'Dwalganup'	5
		1.0% to < 1.5%	'Dinninup'	6
		1.5% to < 2.0%	'Seaton Park'	7
		2.0% and over	'Bacchus Marsh'	8

(*) 26 (+)	Stipules: anthocyanin colouration (in shaded part of canopy)	absent (type S0)	'Uniwager', 'Junee'	1
		veins only (type S1)	'Nungarin'	2
		veins and a band of medium width (type S2)	'Clare'	3
		almost entire surface pigmented (type S3)	-	4
(*) 27	Time to commencement of flowering (50% of the plants with at least one flower)	less than 80 days	'Nungarin'	
		80 to < 90 days	'Dwalganup'	1
		90 to < 100 days	'Daliak'	2
		100 to <110 days	'Uniwager'	3
		110 to < 120 days	'Dinninup'	4
		120 to < 130 days	'Gosse'	5
	Examples are from Perth, Western Australia, sown in early May.	130 to < 140 days	'Mt Barker'	6
		140 to < 150 days	'Leura'	7
		150 to < 160 days	-	8
		160 days and over	'Tallarook'	9
				10
		time to commencement of flowering: _____ days		
28	Inflorescence: number of florets per inflorescence	fewer than 3		1
		usually 3		2
		usually 4		3
		usually 5		4
		more than 5		5
(*) 29	Calyx: area of pigmentation	absent	'Denmark', 'Junee'	1
		present and less than 1/4 tube	'Dwalganup'	2
		1/4 tube	'Dinninup'	3
		1/4 to less than 1/2 tube	-	4
		1/2 tube	'Geraldton'	5
		1/2 to less than 3/4 tube	'Mt Barker'	6
		3/4 tube	'Northam'	7
		3/4 to less than entire tube	'Esperance'	8
		entire tube	'Daliak'	9

30	Calyx: colour of pigmentation	brown		1
		purple		2
		pink		3
		red		4
		brownish purple		5
		purplish brown		6
		brownish pink		7
		purplish pink		8
		reddish pink		9
		reddish purple		10
		purplish red		11
		pinkish red		12
		pinkish purple		13
		pinkish brown		14
		brownish red		15
		reddish brown		16
		RHS Chart No.		
31	Peduncle: hairiness	absent	'Denmark'	1
		very weak	'Gosse', 'Trikkala'	2
		weak	'Clare'	3
		weak to medium		4
		medium	'Daliak'	5
		medium to strong		6
		strong	'Dalkeith'	7
		strong to very strong		8
		very strong	'Dinninup'	9
(*) 32	Stem (runner): hairiness (at late flowering)	absent	'Goulburn', all ssp. *yann-inicum*	1
		very weak		2
		weak		3
		weak to medium	'Junee'	4
		medium	'Daliak', 'Leura', North-am'	5
		medium to strong		6
		strong	'Bacchus Marsh', 'Dalke-ith'	7
		strong to very strong		8
		very strong		9

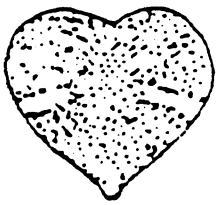
33	Stem (runner): attitude of hairs (at late flowering)	erect	'Mt Barker', 'Geraldton', 'Bacchus Marsh'	3
		semi-appressed	'Dalkeith'	5
		appressed		7
34	Burr: size	small	'Denmark'	3
		intermediate	'Dinninup', 'Larisa'	5
		large	'Dalkeith'	7
35	Burr: burr burial strength (at late flowering)	absent	all ssp. *brachycalycinum*	1
		weak	'Bacchus Marsh'	3
		medium		5
		strong	'Dalkeith'	7
		very strong		9
36	Burr: distribution	distal	'Rosedale', 'Clare'	1
		mainly distal	'Goulburn', 'Karriedale'	2
		mainly crown	'Nungarin','Seaton Park', 'Trikkala', 'Larisa'	3
		crown		4
37	Burr: number of seeds per burr	fewer than 3		1
		usually 3		2
		usually 4		3
		usually 5		4
		more than 5		5
(*) 38	Seed: colour (fresh, mature seed)	white		1
		cream	all ssp. *yanninicum*	2
		amber		3
		purple		4
		purplish black	'Mt Barker', 'Clare'	5
		black	'Seaton Park'	6
39	Seed: weight per 1000 seeds	very low	'Goulburn'	1
		low	'Daliak'	3
		medium	'Seaton Park'	5
		high	'Dalkeith'	7
		very high		9
		weight per 1000 seeds:		
		_____ grams		

(*)	Seed: rate of	less than 10%	'Mt Barker'	1
40	hardseed breakdown	10% to < 20%	'Gosse', 'Nuba'	2
	expressed as	20% to <30%	'Esperance'	3
	percentage hardseed	30% to <40%	'Junee', 'Seaton Park'	4
	four (4) months	40% to <50%	'Geraldton', 'Northam'	5
	after maturity, in a	50% to <60%	'Nungarin'	6
	15°C/60°C	60% to <70%		7
	temperature cabinet.	70% to <80%		8
		80% to <90%		9
	Reference:	90% and over		10
	Quinlivan and			
	Millington (1962)			

VIII Explanations on the Table of Characteristics

Ch 8

Leaflet: pattern of mark

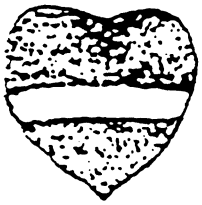


A1

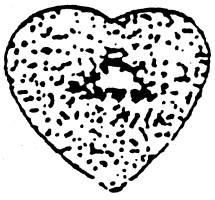
A2

A3

B1

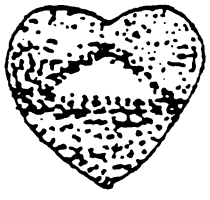


B2



C1

C2



C3

C4

Ch 26

Stipules: anthocyanin colouration

1
absent
(type S0)

2
veins only
(type S1)

3
veins and a band
of medium width
(type S2)

4
almost entire
surface pigmented
(type S3)

IX Literature

Collins, WJ, Francis, CM and Quinlivan, BJ (1984): "Registered cultivars of subterranean clover - their origin, identification and potential use in Western Australia", Bulletin No. 4083 Western Australian Department of Agriculture, Perth, Western Australia.

Francis, CM and Millington, AJ (1965): "Varietal variation in the isoflavone content of subterranean clover: its estimation by a microtechnique", *Aust. J. Agric. Res*: 16: 557-564.

Quinlivan, BJ and Millington, AJ (1962): "The effect of a meditteranean summer environment on the permeability of hard seeds in subterranean clover", *Australian Journal of Agricultural Research*: 13: 377-87.

Southwood, OR and Wolfe, EC (1978): "Identifying and Using Subterranean Clovers", 2nd. edition, Division of Plant Industry Bulletin P473 New South Wales Department of Agriculture.