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INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS

GENEVA

TECHNICAL WORKING PARTY ON AUTOMATION AND COMPUTER PROGRAMS

Sixth Session
Edinburgh, United Kingdom, June 7 to 9, 1988

REPORT

adopted by the Technical Working Party on Automation and Computer Programs

Opening of the Session

1. The sixth session of the Technical Working Party on Automation and Computer Programs (hereinafter referred to as "the Working Party") was held at Edinburgh, United Kingdom, from June 7 to 9, 1988. The list of participants is reproduced in Annex I to this report.

2. Dr. D.C. Graham, Director of the East Craigs Station of the Department of Agriculture and Fisheries for Scotland, welcomed the participants to his station at East Craigs, Edinburgh. The session was opened by Dr. F. Laidig (Federal Republic of Germany), Chairman of the Working Party.

Adoption of the Agenda

3. The Working Party adopted the agenda for its sixth session, which is reproduced in document TWC/VI/1, after having deleted item 11.

Reports on Subjects of Special Interest to the Working Party Raised During the Twenty-Third Session of the Technical Committee and on Questions Raised by Other Technical Working Parties

4. Dr. M.-H. Thiele-Wittig reported on the main subjects of interest to the Working Party raised during the last session of the Technical Committee, referring to the full report on the session reproduced in document TC/XXIII/6 for further information.

5. Mrs. V. Silvey (United Kingdom) added, in particular, the fact that the other Technical Working Parties had raised certain criticism regarding the work of the Technical Working Party on Automation and Computer Programs and had warned of the danger of proposing new methods too fast without taking into account the modalities of testing presently applied by the technical services of different member States.

6. The Working Party specified that most of the new methods were just at the study stage and that this fact should be made more clear. On the other hand, however, discussions and a close cooperation between statisticians, crop experts and organizations would have to take place at the national level so as to understand better each other's wishes and needs.

Combined Over-Years (COY) Analysis

7. The Working Party noted document TC/XXIII/4 Rev. containing a revised version of the description of the combined over-years (COY) criterion for distinctness in DUS trials, prepared according to a suggestion made during the twenty-third session of the Technical Committee. The Working Party further noted documents TWC/VI/6, TWC/VI/7, TWC/VI/8, TWC/VI/10 and TWC/VI/11, as well as further papers prepared by experts from Denmark and the Netherlands and distributed during the session. These documents are reproduced as Annexes II and III to this report.

8. The chairman recalled that the COY analysis had now been under study for several years and that, in addition to the proposed possible adjustment through the Modified Joint Regression Analysis (MJRA), another possible adjustment through the close-pair comparison had been proposed.

Evaluation of the COY Analysis

9. Dr. Weatherup (United Kingdom) explained document TWC/VI/6, giving an evaluation by the United Kingdom of the COY criterion adjusted by MJRA. While the unmodified COY criterion showed a similar stringency to the t-score criterion, modified by the regression, the number of varieties that could be distinguished was increased (in the given case from 85 to 91).

10. Dr. Fuchs (Federal Republic of Germany) explained document TWC/VI/7, giving the evaluation of the COY distinctness criterion using data from the Federal Republic of Germany from the years 1985 to 1987. The results of this evaluation show that for grasses the two-year COY decisions distinguished more varieties than the 2 x 1% decisions, while the three-year COY decisions distinguished less varieties than the 2 x 1% decisions. For maize, after three years, considerably less varieties could be distinguished with the COY analysis (at 5%) than with the 2 x 1% method. The difference between these results and those from the United Kingdom might partly be explained by the different environmental conditions in the Federal Republic of Germany compared to those in the United Kingdom, leading to higher values of λ in the Federal Republic of Germany. The use of the MJR analysis reduced the λ-values for certain characteristics and increased the number of distinct varieties. Continuous decisions could be reached in the Federal Republic of Germany when applying the COY analysis at the 5% level.

11. Mr. Kristensen (Denmark) explained document TWC/VI/8. In Denmark, at present, recording of characteristics would be stopped when a specific variety had proved to be distinct from all other candidates. Therefore, it had been difficult to find sufficient data to apply the COY analysis. The COY analysis without adjustment led to less varieties being found distinct than at present. The COY analysis modified by the MJR analysis led to results close to those reached at present. In certain cases, however, the modified COY analysis led to less distinct varieties. The reason for this might be that the regression coefficient had not been significant.

12. The Working Party agreed that the possible modification of COY analysis by the MJR analysis should be amended by the calculation of the significance of the joint regression. The MJR analysis should only be applied when the regression was significant. Dr. Weatherup will include that calculation in the COY analysis program.

13. Mr. van der Heijden (Netherlands) reported that in the Netherlands the COY analysis had been applied to only a few grass varieties. The results had been similar to those of the 2 out of 3- Method without the application of the MJR analysis. It would, however, have to be considered what would be the minimum number of varieties to allow a meaningful application of the COY analysis.

14. Mr. Grégoire (France) reported that routine application of the COY analysis in France will start only for 1988 data. The results so far received showed that for Festuca varieties the COY analysis permitted more varieties to be distinguished than the 2 x 1% method, while for Dactylis varieties it was the contrary.

Further Refinement of the COY Analysis

15. Mr. Talbot (United Kingdom) explained document TWC/VI/10 proposing a further refinement of the COY analysis in the form of the close-pair comparisons. It considered the fact that the range of variation differed in different years, that the difference between similar varieties tended to vary less than between dissimilar varieties and that, in distinctness testing, the tester was only interested in comparing close varieties. The method would start from what the expert wanted and would give him an estimate of the difference. It would rank the varieties by their over-years mean, calculate the variance of differences between variety means for varieties ranked 1 and 2, 2 and 3 etc., and average the paired variances to give a close-pair variance for the testing of differences between similar varieties.

16. Having studied the above document, the Working Party considered the method to be a useful procedure and one that was not too difficult to explain to the technical experts since it followed closely, and only improved upon what the technical expert was doing at present when comparing two varieties. The members of the Working Party were asked to discuss the results with their national experts. Dr. Weatherup (United Kingdom) will, in cooperation with Mr. Talbot (United Kingdom), incorporate that refinement in the program of the COY analysis as a further possible refinement. The amended program would be circulated to the experts from Denmark, France, the Federal Republic of Germany, the Netherlands and Spain by the end of September 1988. Results of the application of the refinement would be sent by these experts to Mr. Talbot by March 1, 1989.

Application of the COY Analysis to Crops Other than Grasses

17. Mr. Kristensen (Denmark) explained a paper on the comparison between the 2 x 1% rule, the t-score, the COY analysis without adjustment and the COY analysis with adjustment with the MJR analysis for varieties of sugar beet and summer rape in Denmark, distributed during the session and reproduced in Annex II to this report. The COY analysis sometimes allowed the distinction of more varieties than the t-score. The COY analysis adjusted by the MJR analysis sometimes distinguished more varieties than the unmodified COY analysis. The whole study suffered, however, from the fact that only results of few varieties could be used.

18. Dr. Laidig (Federal Republic of Germany) explained document TWC/VI/11 containing results of the application of the COY analysis to data of onion varieties from the Federal Republic of Germany. The document showed that the application of the COY analysis at 5% level to two years of data allowed a few more varieties to be distinguished than the 2 x 1% method. For three years the COY analysis allowed less varieties to be distinguished. Dr. Laidig concluded that the COY analysis was also applicable to varieties of vegetable species. Two problems have, however, become apparent:

(a) not all varieties were really measured but only the comparable ones, and

(b) the LSD was calculated each year from a different set of reference varieties.

19. Mr. van der Heijden (Netherlands) explained a paper on some experience gained with the COY analysis in red beet, mainly prepared for the coming session of the Technical Working Party for Vegetables but also distributed during the session and reproduced in Annex III to this report. The paper showed that with the COY analysis at 1% level more varieties could be distinguished than with the two out of three method and that the adjustment with the MJR analysis allowed even more varieties to be distinguished than with the not adjusted COY analysis. But here again the problem of the low number of varieties arose.

20. The Working Party agreed that in cases in which the values of λ were very small there was no use in applying the MJR analysis. It concluded that, in general it would need to study further the application of the COY analysis to vegetable varieties.

21. The discussions in the Working Party on a minimum number of varieties necessary to enable LSD values that are not too large led to a figure of 10 varieties. This figure will, however, be checked by Dr. Laidig (Federal Republic of Germany) for the next session.

22. The problem of the few candidate varieties for some vegetable species, the few reference varieties and incomplete data led the Working Party to discuss, on the proposal of Mr. Talbot, the possibility of producing estimates for minimum distances of variances and information on whether those estimates are consistent from long range data of preceeding years. Mr. Talbot offered to study this proposal on data from carrots, onions and faba beans and prepare a report on his findings by the end of December 1988.

23. This study should, however, not prevent the application of the COY analysis if sufficient data are available. Experts from the Netherlands would thus study the application of the COY analysis to leek varieties and experts from the Federal Republic of Germany to onion varieties and send their results to the UPOV Office by the end of December 1988. Mr. Law (United Kingdom) will send his results of the application of the COY analysis to sugar beet varieties to the UPOV Office by the end of March 1989.

24. The Working Party also recommended discussing at the national level the possibility of increasing the number of varieties in the trials to reach at least 10 degrees of freedom allowing application of the COY analysis, and/or keeping in addition to the close control varieties a number of (extra) varieties in the trials throughout the years, irrespective of the candidate varieties under test, in order to link the years together.

25. The Working Party furthermore agreed that the application of the COY analysis to vegetable species had to be studied species by species.

26. It finally recalled that in 1989 it had to fix a significance level for the application of the COY analysis to grasses and that that study had therefore also to be continued at the national level.

Testing of Homogeneity in Cross-Fertilized Plants

27. Mr. Talbot (United Kingdom) introduced document TWC/VI/9, containing an updated version of his program for the testing of homogeneity in cross-fertilized plants. With the introduction of the moving average, the method would use the average of the nearest two reference varieties to measure the uniformity of the candidate variety. The advantages of the method would mainly be that

(a) all reference varieties could be used as uniformity standards;

(b) a single criterion for uniformity would be used, and

(c) a comparison would be made against the most similar varieties.

28. Mr. Talbot further explained the first part of document TWC/VI/12 on the evaluation of the above criterion made in the United Kingdom. This explanation was followed by similar explanations made by Mr. Kristensen on his experience in Denmark on evaluation of that criterion and by Dr. Fuchs on his experience in the Federal Republic of Germany, both also reproduced in document TWC/VI/12. They were followed by explanations by Dr. Weatherup (United Kingdom) of a paper with his results on the comparison of the actual uniformity decisions and those found by the over-years uniformity criterion, as distributed during the session and reproduced in Annex IV to this report.

29. The above criterion was considered by the Working Party to offer a great advantage over the present uniformity criterion. It would, however, have to be studied further. The experts from the Netherlands and France will also join the study, while those from the Federal Republic of Germany and the United Kingdom will continue theirs. The results should be sent to the UPOV Office by March 1, 1989.

30. The study should include that on the appropriate levels, which so far had been different between the Federal Republic of Germany and Denmark and the United Kingdom. It should also reflect on how to handle cases where only data of less than nine varieties were available.

Test of Homogeneity in Self-Fertilized Plants

31. Dr. Weatherup (United Kingdom) introduced document TWC/VI/4, prepared by him, on the calculation of maximum tolerable off-type numbers for sample sizes of 1000, 2000, 3000, 4000, and 5000 which contained the same nominal standard as that used in the General Introduction to the Test Guidelines (document TG/1/2, paragraph 20(a)).

32. The Working Party noted that in practice for certain crops quite different maximal tolerable off-type numbers are used. The Technical Committee had also asked the Technical Working Parties to fix in the individual Test Guidelines the sample size and the tolerated off-types.

33. The Working Party agreed that it was not possible to prepare one table of maximal tolerable off-type numbers for all crops. In order to help the Technical Working Parties to find the right tolerances in their Test Guidelines for each species, the Working Party agreed to prepare different sets of different nominal standards (e.g. 0.1%, 1%, 2%, 5%) and of different per cent of acceptance probability (e.g. 95%, 99%) and also give some information on the parameters for the description of the sampling scheme, namely, on the nominal standard, the acceptance probability, on the sample size and on the maximum number of off-types. Dr. Laidig and Dr. Weatherup will prepare the paper by September 15, 1988, to enable it to be submitted to the Technical Committee before being distributed to the Technical Working Parties.

Pairwise Comparison of Varieties for Testing Distinctness

34. Dr. G. Fuchs (Federal Republic of Germany) introduced a paper on the use of close-pair comparisons for testing distinctness distributed during the session and reproduced in Annex V to this report. The introduction was followed by a survey of the methods used in the different member States. This showed that for, measured characteristics, no real pairwise comparisons were made and, except for the forming of groups, the normal UPOV criteria were used. For visually assessed characteristics, no special features were applied. It was stressed in particular that an increase in the number of replications would not be fair as another yardstick would be used.

35. The Working Party asked the other Technical Working Parties to note the above results and to inform it if it foresaw any problems in the pairwise comparison of varieties for distinctness.

Review of Statistical Practices

36. In the absence of Mr. Baltjes (Netherlands), Mr. van der Heijden (Netherlands) introduced document TWC/VI/2 on the promotion of statistics in the testing of distinctness, homogeneity, and stability of new varieties of plants. Limitations on the use of statistical methods could have their cause in the different groups of crops (ornamentals, vegetables, agricultural

crops), in the lack of randomization of the layout of the trials prepared, for example, to facilitate visual observations, or in the lack of understanding of new methods by the technical experts. It was necessary to explain these methods better to the technical experts, to take more time to listen to any problems the technical experts had and whether possible statistical methods could help in solving them, and to develop more non-parametric methods. A Review of Statistical Practices prepared by Mrs. Campbell (United Kingdom) after the session is reproduced in Annex X to this report.

37. The Working Party noted several problems with respect to qualitative visually observed characteristics. However, before being able to define the problems which are of real practical significance, the Working Party wanted to draw the attention of the crop experts to the following and ask for their advice:

(a) how best to assign 1 to 9 notes (scores) when the range of expression of the characteristic can be much wider in some years than in others;

(b) optimum methods of analysis of data made by visual observation when decisions of distinctness and homogeneity have to be made;

(c) how to use historic information on 1 to 9 notes for, say, reference varieties, in order to make comparisons with current candidates, for example, to select those reference varieties which are closest to the candidates and should be grown in tests with them;

(d) problems of finding the most efficient and effective way of comparing very small numbers of varieties, sometimes only pairs of varieties;

(e) ways of standarizing between centers and Notes for reference varieties so that a new variety is given a similar Note at each center.

38. The Working Party recommended to the other Technical Working Parties that, in their coming sessions, they reserve some time to allow an invited statistician to explain certain of the above problems to them.

39. Dr. Laidig (Federal Republic of Germany) will prepare by the end of December 1988 a report on the possibilities of analyzing with the computer data obtained from the application of electrophoresis. Mr. Grégoire (France) will also prepare by the same date a short report on how he sees these possibilities. The Technical Working Party for Agricultural Crops should be informed of that planned study and be invited to inform Dr. F. Laidig of any question it might wish to be taken up in that report.

Non-parametric methods

40. The Working Party thanked Mr. Baltjes (Netherlands) for the excellent document TWC/VI/3 on the use of non-parametric statistics in the testing of distinctness, homogeneity and stability. It asked for distribution of the document to the other Technical Working Parties for information.

Description of Varieties

41. Mrs. Campbell (United Kingdom) introduced a summary of the results of the questionnaire on the description of varieties distributed with circular U 1291. The summary was further updated during the session and the new version is reproduced in Annex VI to this report. The Working Party asked for that version to be distributed also to the Technical Working Party for Agricultural Crops for information.

42. The Working Party asked Mr. Talbot (United Kingdom) to circulate again the program for deriving at a stabilized variety description. Results should be sent to Mr. Talbot before March 1, 1989, and a summary of these results to the Office of UPOV by the end of March 1989.

43. Dr. Weatherup (United Kingdom) introduced document TWC/VI/5 containing possible definitions of the term "similiar variety." He proposed three different possibilities,

(a) the variety with the smallest maximum t-value,
(b) the variety with the smallest distance D^2, and
(c) the variety with the smallest D^2 value of the varieties having a t-value less than a defined amount.

44. During the session, a short survey of how the similar variety was found in the member States at present revealed large differences. Some countries did not indicate them at all in their descriptions or only in certain cases where the difference was really very small. Some grouped the varieties and looked for varieties differing only in one characteristic from the new variety then selected the variety with the smallest difference. This was considered by some experts to be comparable to the maximum t-value method proposed by Dr. Weatherup. The method applied also varied depending on the species. Some considered it to be impossible to indicate for ornamental varieties which characteristic made the new variety distinct and thus they could not also indicate a similar variety.

45. Dr. Weatherup (United Kingdom) offered to evaluate the proposals in document TWC/VI/5 and to compare them with the previous method applied in the United Kingdom. He would also include scores in that evaluation which would be sent to the Office of UPOV before the end of December 1988.

46. The Working Party further asked that the other Technical Working Parties should be informed of the results of the above discussion and asked them what they understood under a similar variety. If, thereafter, they considered that they needed help in understanding, they should say so and indicate in which respect help was needed.

Report on the Existing Data Base Management Systems

47. Mrs. Campbell (United Kingdom) reported on the results of the survey made with circular U 1291 on the data base management systems used in the different member States. The summary is reproduced in Annex VII to this report. She stressed that, in future, there would be increased need for data exchange and that it would be important to set up systems that would make access by other member States to data bases easier.

48. The Working Party agreed that it was necessary to be aware of the data bases in the other member States and that it should work towards a common query language. As the Structured Query Language (SQL) was already used in several member States, offices should, when buying new data base systems, try to ensure that they use SQL. As more and more micro computers are connected to main frame computers, efforts should also be made to ensure that both used the same language.

Programs Which Can Readily be Assimilated into Other Plant Variety Computer Systems

49. Mrs. Campbell (United Kingdom) reported on the results of a request for information on exchangeable software, as distributed with circular U 1291. The results are reproduced in Annex VIII to this report. The Working Party noted this updated library and agreed to continue updating it. Changes occurring in the member States should be reported to Mrs. Campbell to enable her to prepare a further updated version by the end of December 1988. The Working Party considered it useful to include in that library also the General Statistical Program Package (GENSTAT).

Progress Report on Machine Vision Techniques for Variety Identification

50. Mrs. Silvey (United Kingdom) reported on the progress made with the study on machine vision techniques as reported upon during the last session of that Working Party, as well as during the last session of the Technical Committee. She further informed the Working Party that this subject will form a special item during the coming session of the Workshop on the Use of New Technology in the Examination of Varieties, scheduled to be held on September 27 and 28, 1988, at Cambridge, United Kingdom. It was expected that, at the end of June 1988, a prototype will be available at the NIAB at Cambridge, United Kingdom, which could identify wheat varieties in three minutes. For the future, it was planned to study the application to barley to assist the grain trade. Further study would concern the application for statutory purposes.

51. Mr. Evans (United Kingdom) reported on the study to apply the above method to identify onion varieties. The first results of a test involving the photographing of onion bulbs of a certain group of varieties and evaluating the picture with that method, concentrating on height, diameter and width of widest point to base were very promising. The results obtained by the machine were exactly the same as those obtained by actual measurement of these characteristics. The method would allow an acurate recording and a fast decision. This year, all onion varieties will be checked with that method if possible. Mr. Evans promised to prepare a written report on the results before the end of January 1989 for distribution to the Working Party.

52. Mr. Bar-Tel reported on discussions on the measuring of petals of carnations with that methods held during the last meeting of the Subgroup on Carnation of the Technical Working Party for Ornamental Plants and Forest Trees. He will prepare a report on those measurements by the end of December 1988.

53. The Working Party considered that the above method

(a) might be used in the future as an automated system for data capturing, eliminating the need for data entering of otherwise recorded data;

(b) could allow the observation of several additional characteristics, and

(c) would enable the development of a system that would make the computer decide whether a candidate variety was distinct or not. All experts would study at home the development in their country with respect to that method.

Minimum Distances Between Varieties

54. The Working Party noted that this subject had been rediscussed in several bodies of UPOV during last year's autumn sessions. The Working Party specially noted paragraphs 14 to 17 of Annex V of document TC/XXIII/6. Having had a long discussion on how it could be of help in the given problems, it finally agreed to ask the other Technical Working Parties to select two species each and certain characteristics within these species which posed special problems. For these selected characteristics, data of the whole collection of varieties for more than two years should be listed, together with an explanation of the problems encountered for which they would ask advice, as well as present practice or rules applied or the present solutions used to solve the problems, and any other information on desired solutions. The information from the Technical Working Parties should reach Mr. Law (United Kingdom) before the end of September 1988. Mr. Law would study them to see whether they could be circulated straight to the members of the Working Party or whether certain additional information might be required from the Technical Working Parties beforehand.

55. The Working Party noted that already, for certain species, a significant difference between a candidate variety and another variety would not necessarily lead to the candidate variety being accepted as a distinct new variety. For reasons which were not necessarily connected with the growing, test authorities often demanded a minimum distance which, for certain characteristics, would be considerably higher than that demanded according to the statistical evaluation of the test results. One example was the difference in earliness of at least one day for certain species.

Questions Raised by Other UPOV Technical Working Parties

56. The Working Party noted that no special questions had been raised directly by the other UPOV Technical Working Parties. Mr. Evans (United Kingdom) referred to the plans of the Technical Working Party for Vegetables as mentioned in document TWV/XX/13 Prov., paragraphs 14 to 17. However, this year's sessions still have to take place in coming weeks. The Working Party therefore preferred to await the outcome of these sessions before discussing any question which might have been raised in documents for the sessions of the other Technical Working Parties.

57. With respect to the wish for a program which, on the occasion of the revision of a given UPOV Test Guidelines document, would automatically change all existing variety descriptions to follow the revised version of that Test Guidelines document, the Working Party said that this was in principle possible. It would, however, require first of all a suitable transformation of each old characteristic into the new characteristic and then a computer program that would execute that transformation. In certain cases, the transformation might, however, not be easy, as was shown by the example in

which a color characteristic with the states "white" and "black" was enlarged by a third state "yellow." For the transformation, the technical experts should discuss their wishes with their national computer experts.

58. Mr. George (United Kingdom) mentioned also that for the UPOV Models for the Interim Report on the Examination of a Variety and for the Request of Examination Results information at present had to be included in two pages each. He wondered whether this procedure could not be made easier by including the required information in one page thereby also saving a lot of paper. Mr. Bar-Tel (Israel) further proposed that the forms should be amended so that:

(a) one line was reserved for one item only, and

(b) all questions were presented in one column, leaving a separate column for answers only.

59. The Working Party considered that the above proposals would facilitate readability and printing by computer and therefore recommended to the Technical Committee to consider them favorably. Mrs. Campbell (United Kingdom) will prepare a proposal for amended forms before the end of July for transmission to the Technical Committee via the Office of UPOV.

Future Program, Date and Place of Next Session

60. At the invitation of the expert from Spain, the Working Party agreed to hold its seventh session in Madrid, Spain, from May 17 to 19, 1989. The meeting would start at 9.00 a.m. on May 17, 1989, and close at noon on May 19, 1989. During its session, the Working Party would either continue or commence discussions on the following items:

(i) Report on subjects of special interest to the Working Party raised during the twenty-fourth session of the Technical Committee and on questions raised by other Technical Working Parties (oral reports).

(ii) Combined Over-Years (COY) Analysis:

(a) Dr. Weatherup (GB) to include a program for the calculation of significance of joint regression and a program for the close-pair comparison (in cooperation with Mr. Talbot) in the program for the COY analysis and to circulate the amended program to DE, DK, ES, FR, NL by the end of September 1988.

(b) The results of the evaluation of the amended program concerning the pairwise comparison to be sent to Mr. Talbot (GB) by March 1, 1989. Mr. Talbot to prepare a summary of the results before the end of March 1989.

(c) All to have a final study on the significance level for grasses to enable a definite decision.

(d) Dr. Laidig (DE) to check the minimum number of varieties necessary for a reasonable application of the COY analysis considered to be ten varieties for three years.

(e) All to study the possibility of increasing the number of varieties up to a minimum allowing the meaningful application of the COY analysis and of keeping some extra varieties in the trials over several years.

(f) Mr. Talbot (GB) to prepare before the end of December 1988 a proposal for an estimate for minimum distances and variances for cases where too few varieties do not allow the application of the COY analysis.

(g) All to study the application of the COY analysis to further species. Mr. van der Heijden (NL) to prepare before the end of the year a study on its application to leek and Dr. Laidig (DE) on onion, Mr. Law before the end of March 1989 on sugar beets.

(iii) Testing of homogeneity in cross-fetilized plants:

Mr. Talbot to circulate his program to NL + FR. DE, FR, GB, and NL to send further results of the application of the Method by March 1, 1989, to UPOV. The study to include the search for an appropriate significance level and on what to do if only less than nine varieties were available.

(iv) Testing of homogeneity of self-fertilized plants:

Dr. Laidig and Dr. Weatherup to prepare a paper on nominal standards and acceptance probabilities to be sent to UPOV before September 15, 1988, for transmission to the Technical Committee.

(v) Pairwise comparison of varieties for testing distintness

To ask the other Technical Working Parties if they foresaw any problems in pairwise comparison of varieties for distinctness.

(vi) Review of statistical practices:

Dr. Laidig to prepare, before the end of of December 1988, a report on the analysis of electrophoresis data by computer. Mr. Grégoire to prepare, before the end of December 1988, a short report on the same subject.

The other Technical Working Parties to be questioned on visual observations.

(vii) Description of varieties

Mr. Talbot (GB) to circulate his program for obtaining stabilized variety descriptions. The member States to send their results to Mr. Talbot before March 1, 1989. Mr. Talbot to send his summary to UPOV before the end of March 1989.

Dr. Weatherup to evaluate before the end of December 1988 his proposals on the most similar variety compared with the old method. The other technical working parties to be asked how they handle this subject.

(viii) Programs which can readily be assimilated into other plant variety computer systems:

Updated information, including information on GENSTAT used, to be sent to Mrs. Campbell before December 1988.

(ix) Progress report and machine vision techniques for variety identification:

(a) Mr. Evans (GB) to report before the end of January 1989 on experience with machine vision techniques applied to onions.

(b) Mr. Bar-Tel to report before the end of December 1988 on experience with machine vision techniques applied to petals of carnations.

(x) Minimum distances between varieties:

The Technical Working Parties to send to Mr. Law before the end of September 1988 their questions and data on two selected species for checking and distribution to the members of the Working Party via the UPOV Office by March 1, 1989.

(xi) Questions raised by other UPOV Technical Working Parties.

Mrs. Campbell to prepare before the end of July 1988 for presentation to the Technical Committee proposals for a revision of the UPOV Model for the Request of Examination Results and of the UPOV Model for the Interim Report on the Examination of a Variety.

Visits and Demonstrations

61. On the afternoon of June 7, the Working Party visited the testing station of the Department of Agriculture and Fisheries for Scotland, at East Craigs and on the afternoon of June 8, it visited the trial grounds at Gogarbank Farm. Thereafter, Mr. Green gave a comprehensive explanation of the data base for pisum at East Craigs which comprised all kinds of information on each variety. Annex IX reproduces the legend for that data base and some short information from the slides shown during Mr. Green's explanation.

62. This report has been adopted by correspondence.

[Nine Annexes follow]

ANNEX I

LIST OF PARTICIPANTS AT THE SIXTH SESSION OF THE TECHNICAL WORKING PARTY ON AUTOMATION AND COMPUTER PROGRAMS, EDINBURGH, UNITED KINGDOM, JUNE 7 TO 9, 1988

I. MEMBER STATES

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[Annex II follows]

Comparisons between 2 x 1%-rule, T-score, COY without and with MJRA for sugar beet and summer rape in Denmark.

In the autumn/winter 1987 we had to decide for the following number of candidates:

Suger beet:

5 candidates, which had been in test for 3 years

5 candidates, which had been in test for 2 years

Summer rape:

5 candidates, which had been in test for 2 years.

For sugar beet the candidates, which had been in test for 3 years, were all accepted as distinct. Only 1 of the 5 varieties, which had been in test for 2 years, were accepted as distinct. The remaining 4 varieties were allowed a 3rd year test.

For summer rape 1 variety was accepted as distinct, 3 varieties were allowed a 3rd year test and 1 variety was withdrawn by the breeder.

During the separation work we had to use a modified rule where we allowed pairs of varieties to be distinct, if two (or more) characters were significant at a higher level (in stead of the usual 1% level).

For sugar beet the calculations are based on 26 characters. Only 11 characters are directly recorded. The additional 15 charcters are derived characters. The characters are:

number	name	
k001	Leaf: Length blade + petiole	
k005	Petiole: Width at basis	
k011	Root: Weight	
k012	Root: Length	
k013	Root: Height above ground	
k014	Root: Max. diameter	
k017:	Root: 10*cuberoot (weight)	$10*\sqrt[3]{k011}$
k018:	Root: 10*Length/cuberoot (weight)	$10*k012/\sqrt[3]{k011}$
k019	Root: Height above ground/cuberoot (weight)	$k013/\sqrt[3]{k011}$
k020	Root: Max diameter/cuberoot (weight)	$k014/\sqrt[3]{k011}$
k023	Root: Height above ground/length	100*k013/k012

k026	Root: 100*Length/max. diameter	100*k012/14
k027	Root: Percent dry matter	
k029	Root: Percent sugar	
k030	Root: $NH\text{-}N_2$	
k031	Root: Potassium	
k032	Root: Sodium	
k033	Root: $NH\text{-}N_2$*100/Potassium	100*k030/k031
k034	Root: $NH\text{-}N_2$*100/Sodium	100*k030/k032
k035	Root: 100*potassium/sodium	100*k031/k032
k036	100*root length/leaf length	100*k012/k001
k038	Root: Pure sugar	k029-(0.343(k031*k029/39.10/100+k032*k029/22.99/100)+0.094*k030*k029/14.01/100+0.29)
k039	Root: $NH\text{-}N_2$/percent sugar	k030*769.2/k029
k040	Root: Potassium/percent sugar	k031*769.2/k029
k041	Root: sodium/percent sugar	k032*769.2/k029
k042	Root: Impurity value	10*k039+2.5*k040+3.5*k041

In summer rape only 6 characters are included in the analysis - all directly recorded. The characters are:

number	name
k001	Stem: Length
k002	Stem: Height to first branch with silique
k005	Stem: Numbers of second order branches with silique
k007	Silique: Length
k009	Silique: Length of beek
k010	Silique: Numbers of seeds

The results of the comparisons between the 4 methods are given in table 1 and 3. For alle the candidates in question the COY with MJRA separates most varieties. The methods COY (1%), T-score and 2*1% never separate less pairs than COY (1%) with MJRA.

COY with MJRA fails to separate a few pair, which has been separated by COY without MJRA. However this seems only to be the case when that pair is only marginally significant at the 1% level of significance and on average more pairs of varieties are separated with MJRA than without MJRA.

The fact that COY at the 1% level of significance separates more pairs than the T-score and 2*1% methods seem to be in good accordance with the generally rather low π-values. Only 1 sugar beet character and 1 summer rape charcter have a π-value greater than 1.5 (table 2 and 4). In most cases the π-values become smaller when the MJRA-analysis is used. There seem to be a tendency that the largest reduction in the π-values is found when the π-values are high in the ordinary COY-analysis (figure 1).

A summary of the 3 years tested at 1% and 5% level of significance is given for the sugar beet candidates in table 5.

The T-score, 2*1% and 2*5% method did not result in any distinct varieties.

The effect of changing from T-score to the 1% COY or 1% COY with MJRA must be expected to result in slightly more distinct varieties. Changing from T-score to the 5% COY and 5% COY with MJRA in sugar beet must be expected to result in an appreciable higher number and distinct varieties.

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sugbeet.kk

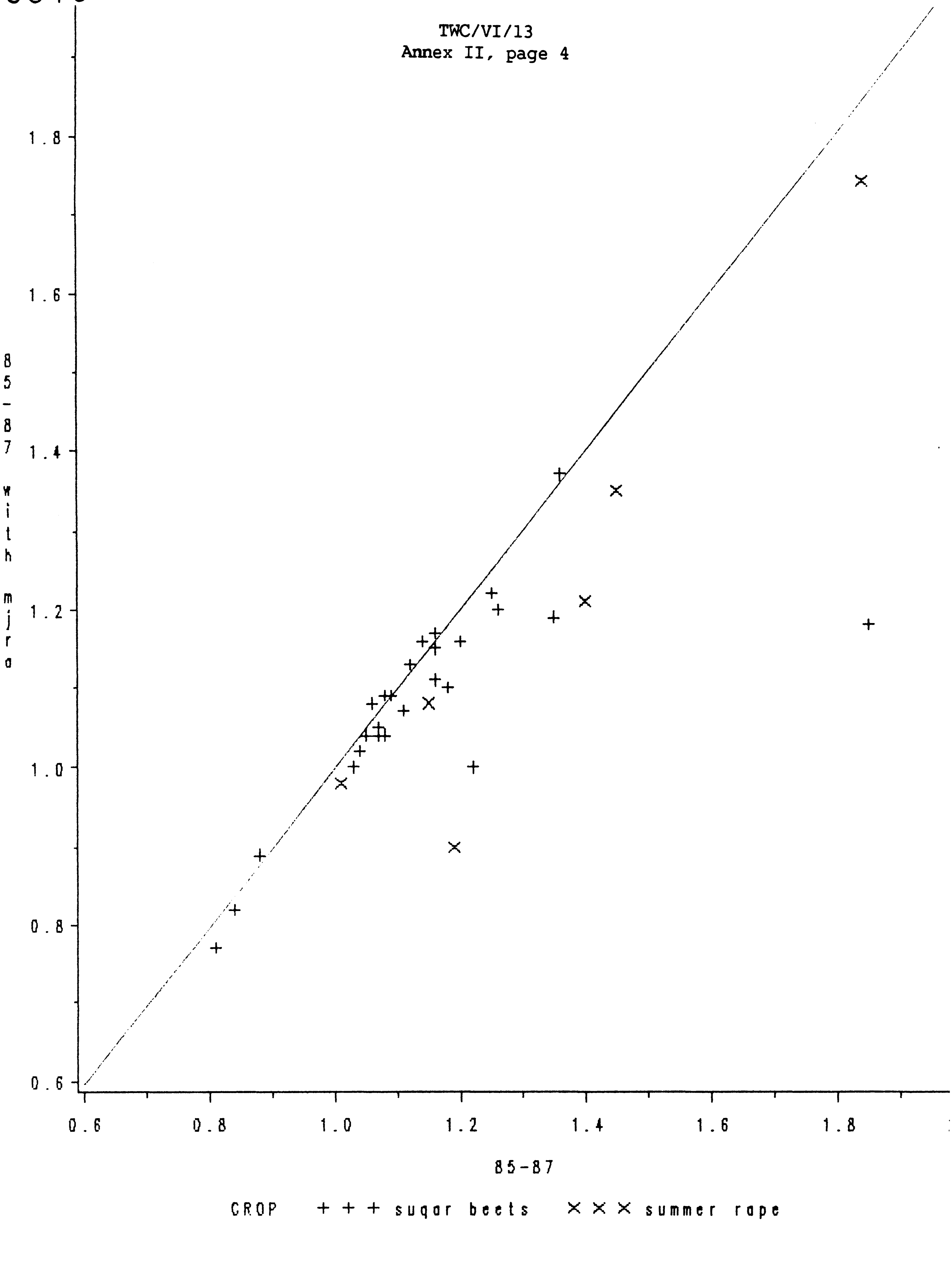

Figure 1. Plot of λ-values with and without COY based on 1985-1987.

Table 1. Non-distinct pairs of varieties in sugar beet.

Candi-date	Trial years	Decision 87/88	2*1%	T-Score	1 % COY	1 % COY(MJRA)	Varieties in test
V	83-85*		-	3	2	-	27
X	83-85*		-	11	8	-	27
Y	83-85*		-	7	5	-	27
Z	83-85*		-	5	5	-	27
A	85-87	D	12	8	1	0	27
B	85-87	D	9	6	4	3	27
C	85-87	D**	17	14	10	10	27
D	85-87	D	15	10	7	7	27
E	85-87	D	17	12	7	5	27
F	86-87	3. year	24	18	3	3	28
G	86-87	3. year	22	13	8	8	28
H	86-87	3. year	24	18	10	8	28
I	86-87	3. year	21	13	6	3	28
J	86-87	D**	19	14	2	0	28

*) reproduced from TWC/IV/6

**) those two varieties are accepted as distinct because of colouring (not included in the analysis). For the remaining varieties the distinctness is based on more charcters beeing distinct at a lower level.

Table 2. π-values for sugar beet 1985-87, Denmark.

Character	π-values without MJRA	π-values with MJRA
1	1.08	1.09
5	1.26	1.20
11	1.04	1.02
12	1.06	1.08
13	1.16	1.17
14	1.20	1.16
17	1.03	1.00
18	1.16	1.15
19	1.14	1.16
20	1.36	1.37
23	1.85	1.18
26	1.25	1.22
27	1.16	1.11
29	1.07	1.04
30	1.12	1.13
31	1.35	1.19
32	0.84	0.82
33	1.18	1.10
34	1.05	1.04
35	0.88	0.89
36	1.11	1.07
38	1.08	1.04
39	1.09	1.09
40	1.22	1.00
41	0.81	0.77
42	1.07	1.05

Table 3. Non-distinct pairs of varieties in summer rape.

Candidate	Trial years	Decision 87-88	2*1%	T-Score	1% COY	1% COY(MJRA)	Varieties in test
A	86-87	D	5	3	5	2	27
B	86-87	3. year	22	15	6	6	27
C	86-87	3. year	22	10	6	4	27
D	86-87	3. year	21	10	6	5	27
E	86-87	withdr.	21	13	6	3	27

Table 4. π-values for summer rape.

Character	π-values without MJRA	π-values with MJRA
1	1.19	0.90
2	1.01	0.98
5	1.45	1.35
7	1.84	1.74
9	1.40	1.21
10	1.15	1.08

Table 5. Distinctness test in Denmark.

Sugar beet 1985-87.

		T-Score, 2*1% or 2*5% d	nd	
COY 1%	d	0	0	0
	nd	0	5	5
COY(MJRA) 1%	d	0	1	1
	nd	0	4	4
COY 5%	d	0	3	3
	nd	0	2	2
COY(MJRA) 5%	d	0	2	2
	nd	0	3	3
		0	5	5

[Annex III follows]

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UPOV - TWV XXI, Wageningen 1988

Some experiences with COY-analysis in red beet

During the last 3 years we had red beet trials. In the first scheme (1) (see Annex I) the included varieties and the years in trial (1, 2 or 3 times "x") are presented. Only for those varieties that were included all 3 years we initially applied the COY-analysis.

These varieties are:
- Mobile
- Monotop
- Monopoly
- KRT 40 (= SG 144)
- Monorondo

The following 3 tables (2, 3, 4) show the means per year for 8 characteristics:

1 Petiole length (cm)
2 Length of leaf blade (cm)
3 Width of leaf blade (cm)
4 Root diameter (mm)
5 Root length or heighth (mm)
6 Total leaf length (cm) [1 + 2]
7 Ratio root heighth/root diameter
8 Ratio root diameter/root heighth

and the 'within standard error', LSD-values and the 'degrees of freedom (DF)'.

The next table (5) shows the variety means over years and the 'year mean square', 'variety mean square', 'variety * year mean square', F1-ratio, 'variety * repetition mean square', F2-ratio, 'between standard error' and 'within standard error'.

Tables 6 to 15 show the 'significance levels', the 'combined analysis', the 'T-values' and the 'F3-values'.
Characteristics as explained before.

D = distinct }
ND = not distinct } ----> for the 2/3 method and F3-value
NS = not significant ----> for COY-analysis

Further details might be clear, because most explanatory texts are in English.
Under significance levels:

"1" means 'significant at 1%'
"5" means 'significant at 5%'

We also studied the applicability of Modified Joint Regression Analysis (= MJRA) and its effect on the number of positive decisions. The effect of this technique is not the same for all characteristics (see tables 16 to 25 ~~of Annex I and Annex II~~).

Because only 5 cultivars were included during all three years, the COY-analysis was also applied for the results of "85 + 86" and of "86 + 87". This resulted in larger numbers of comparisons between pairs; 24 and 21 respectively (see tables 26 to 31 of Annex I, as examples). MJRA was applied for these data too (see II and III of the summary; Annex II).

A summary of the number of positive decisions for 2 out-of-3 years (2/3) or 2 out-of 2 years (2/2) and for COY-analysis is included (at the 1% level) together with the effect of the application of MJRA (see Annex II).

Comments:

- 'KRT 40' is a recently reported application;
- 'KRT 40' cannot be distinguished from 'Monopoly' by one of the measured characteristics, but only by small morphological differences;
- Although this example for 3-year results is of a small size, we think that there might be good prospects for the use of the COY-technique;
- A consequence of the application of this analysis is that we need to include more varieties in our tests during subsequent years than we did. This results in bigger trials than we normally have.
- COY-analysis has more discriminative power than the 2/3-method;
- Adjustment for high F3-values does not charge the outcome of COY-analysis itself;
- Some charateristics show to be somewhat "jumping" for particular variety-pairs, despite their low F2-value. In this respect, a decision at 5% probability level seems to be somewhat premature.
  Therefore more triplets of years with more varieties included should be studied. However, such triplets are not available for this crop.
- The application of MJRA tends to be more discriminative although not for all characteristics;
- COY-analysis combined with MJRA applied for two years-results increases the discriminative power very much at the 1% level. We should wonder if this level isn't too high in the case we apply COY on two year results only. Maybe the level should be 0.1% or 0.5%.
  The high discriminative power might be due to the low number of varieties used. The minimum number of varieties necessary to use MJRA should be studied more detailed.

Wageningen, 31 May 1988
RIVRO; HB/GH/NvM

UPOV - TECHNICAL WORKING PARTY VEGETABLES XXI

WAGENINGEN, 1988.

Scheme (1):

Red Beet Varieties included in trials 1985, 1986 and 1987:

Nr	Rasnaam	1	2	3	4	5	6	7	8
18	DETROIT-RONDORO	x	x	x	x	x	x	x	x
16	GLADORO	xx	xx	xx	xx	xx	xx	xx	xx
13	KOGEL RZ	xx	xx	xx	xx	xx	xx	xx	xx
19	KRT 38	x	x	x	x	x	x	x	x
20	FARANDO	x	x	x	x	x	x	x	x
21	DETROIT-TARDEL	x	x	x	x	x	x	x	x
14	KRT 41	xx	xx	xx	xx	xx	xx	xx	xx
15	LIBERO	xx	xx	xx	xx	xx	xx	xx	xx
22	BIKORES	x	x	x	x	x	x	x	x
23	CROSBY'S EGYPTIA	x	x	x	x	x	x	x	x
24	DETROIT-FARO	x	x	x	x	x	x	x	x
25	LEO	x	x	x	x	x	x	x	x
1	MOBILE	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
2	MONOTOP	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
10	KRT 39	xx	xx	xx	xx	xx	xx	xx	xx
3	MONOPOLY	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
6	KRT 40	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
4	MONORONDO	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
26	KRT 36	x	x	x	x	x	x	x	x
27	RZ 505 - ALLEGRO	x	x	x	x	x	x	x	x
5	MONOGRAM	x x	x x	x x	x x	x x	x x	x x	x x
28	KRT 35	x	x	x	x	x	x	x	x
8	MONA	xx	xx	xx	xx	xx	xx	xx	xx
7	MONODET	xx	xx	xx	xx	xx	xx	xx	xx
11	RZ 509	x	x	x	x	x	x	x	x
12	DET. LORA	x	x	x	x	x	x	x	x
17	RED ACE F1	x	x	x	x	x	x	x	x
9	ALVRO-MONO	x	x	x	x	x	x	x	x

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Geerhoek Vak: G 4

(2)

	1 BLADSTEE LLENGTE	2 BLADSCHI JFLENGTE	3 BLADSCHI JFBREEDT	4 KNOLDIAM ETER IN	5 KNOLHOOG TE IN MM	6 BLD.STL. +BLD.SCH	7 KNOLH/KN OLDIAM	8 KNOLDIAM /KNOLH
1 MOBILE	20.400	19.230	10.930	74.750	71.250	39.630	0.950	1.060
2 MONOTOP	19.850	18.220	11.980	73.180	68.330	38.070	0.930	1.080
3 MONOPOLY	22.580	18.430	11.630	69.720	69.550	41.020	1.000	1.020
4 KRT 40	22.580	18.550	12.000	71.820	68.100	41.130	0.950	1.070
5 MONORONDO	26.770	19.900	12.520	64.480	62.570	46.670	0.970	1.050
WITHIN SE	1.280	0.588	0.386	1.943	2.336	1.664	0.039	0.035
LSD AT 5%	3.775	1.736	1.139	5.732	6.890	4.908	0.115	0.103
LSD AT 1%	5.149	2.368	1.554	7.817	9.397	6.694	0.157	0.140
D.F.	20	20	20	20	20	20	20	20

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Geerhoek Vak: G 4

(3)

	1 BLADSTEE LLENGTE	2 BLADSCHI JFLENGTE	3 BLADSCHI JFBREEDT	4 KNOLDIAM ETER IN	5 KNOLHOOG TE IN MM	6 BLD.STL. +BLD.SCH	7 KNOLH/KN OLDIAM	8 KNOLDIAM /KNOLH
1 MOBILE	23.580	19.900	12.680	75.830	69.080	43.480	0.920	1.130
2 MONOTOP	18.650	17.300	12.970	68.420	63.500	35.950	0.940	1.090
3 MONOPOLY	23.500	18.850	13.130	76.920	78.670	42.350	1.030	0.990
4 KRT 40	22.200	19.050	13.530	69.750	68.500	41.250	0.990	1.030
5 MONORONDO	26.170	21.030	14.530	63.500	69.250	47.200	1.100	0.920
WITHIN SE	0.904	0.569	0.454	2.172	3.278	1.073	0.045	0.062
LSD AT 5%	2.740	1.727	1.377	6.589	9.944	3.256	0.138	0.188
LSD AT 1%	3.803	2.397	1.910	9.145	13.801	4.518	0.191	0.261
D.F.	14	14	14	14	14	14	14	14

(4)

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	1 BLADSTEE LLENGTE	2 BLADSCHI JFLENGTE	3 BLADSCHI JFBREEDT	4 KNOLDIAM ETER IN	5 KNOLHOOG TE IN MM	6 BLD.STL. +BLD.SCH	7 KNOLH/KN OLDIAM	8 KNOLDIAM /KNOLH
1 MOBILE	22.510	18.400	13.180	58.110	56.330	40.910	0.990	1.050
2 MONOTOP	18.390	16.500	13.620	60.000	57.000	34.890	0.970	1.070
3 MONOPOLY	21.110	17.820	13.320	61.670	57.670	38.590	0.950	1.090
4 KRT 40	20.690	17.690	13.530	62.560	56.890	38.160	0.930	1.120
5 MONORONDO	24.340	18.640	14.740	55.560	58.330	42.990	1.060	0.970
WITHIN SE	0.711	0.356	0.304	2.654	2.551	0.882	0.016	0.017
LSD AT 5%	2.155	1.079	0.922	8.051	7.740	2.674	0.049	0.050
LSD AT 1%	2.991	1.497	1.280	11.174	10.742	3.711	0.068	0.069
D.F.	14	14	14	14	14	14	14	14

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VARIETY MEANS OVER YEARS

	1 BLADSTEE LLENGTE	2 BLADSCHI JFLENGTE	3 BLADSCHI JFBREEDT	4 KNOLDIAM ETER IN	5 KNOLHOOG TE IN MM	6 BLD.STL. +BLD.SCH	7 KNOLH/KN OLDIAM	8 KNOLDIAM /KNOLH
1 MOBILE	22.163	19.177	12.263	69.563	65.553	41.340	0.953	1.080
2 MONOTOP	18.963	17.340	12.857	67.200	62.943	36.303	0.947	1.080
3 MONOPOLY	22.397	18.367	12.693	69.437	68.630	40.653	0.993	1.033
4 KRT 40	21.823	18.430	13.020	68.043	64.497	40.180	0.957	1.073
5 MONORONDO	25.760	19.857	13.930	61.180	63.383	45.620	1.043	0.980
YEAR MS	7.995	8.124	14.998	633.634	689.679	35.012	0.005	0.003
VARIETY MS	52.491	8.048	3.401	106.814	46.305	99.333	0.015	0.017
VAR.YEAR MS	3.461	0.576	0.163	28.320	39.030	5.064	0.005	0.007
F1 RATIO	15.166	13.970	20.801	3.772	1.186	19.614	2.790	2.297
VAR.REP MS	3.204	0.827	0.447	15.012	21.917	5.149	0.004	0.005
F2 RATIO	1.080	0.697	0.365	1.886	1.781	0.984	1.350	1.435
BETWEEN SE	0.620	0.253	0.135	1.774	2.082	0.750	0.024	0.029
WITHIN SE	0.597	0.303	0.223	1.292	1.561	0.756	0.021	0.024

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COMPARISONS BETWEEN 1 MOBILE AND 2 MONOTOP
T VALUES POSITIVE IF MOBILE LARGER THAN MONOTOP

	SIGNIFICANCE LEVELS YEARS 85	86	87		COMBINED ANALYSIS T	PROB	SIG	T VALUES YEARS 85	86	87	F3	P(F3)	
1 BLADSTEELLENGTE	+	+1	+1	D	3.65	0.007	**	0.30	3.86	4.10	2.35	0.16	D
2 BLADSCHIJFLENGTE	+	+1	+1	D	5.13	0.001	***	1.21	3.23	3.78	1.65	0.25	D
3 BLADSCHIJFBREEDT	-	-	-	ND	-3.11	0.014	*	-1.92	-0.45	-1.02	1.49	0.28	D
4 KNOLDIAMETER IN	+	+5	-	ND	0.94	0.374	NS	0.57	2.41	-0.50	1.17	0.36	ND
5 KNOLHOOGTE IN MM	+	+	-	ND	0.89	0.401	NS	0.88	1.20	-0.19	0.38	0.70	ND
6 BLD.STL.+BLD.SCH	+	+1	+1	D	4.75	0.001	**	0.66	4.96	4.83	2.85	0.12	D
7 KNOLH/KNOLDIAM	+	-	+	ND	0.19	0.851	NS	0.36	-0.31	0.87	0.15	0.86	ND
8 KNOLDIAM/KNOLH	-	+	-	ND	0.00	1.000	NS	-0.41	0.45	-0.84	0.24	0.79	ND

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Geerhoek Vak: G 4

COMPARISONS BETWEEN 1 MOBILE AND 3 MONOPOLY
T VALUES POSITIVE IF MOBILE LARGER THAN MONOPOLY

	SIGNIFICANCE LEVELS YEARS 85	86	87		COMBINED ANALYSIS T	PROB	SIG	T VALUES YEARS 85	86	87	F3	P(F3)	
1 BLADSTEELLENGTE	-	+	+	ND	-0.27	0.797	NS	-1.20	0.06	1.39	1.42	0.30	ND
2 BLADSCHIJFLENGTE	+	+	+	ND	2.26	0.053	NS	0.96	1.30	1.15	0.14	0.87	ND
3 BLADSCHIJFBREEDT	-	-	-	ND	-2.26	0.054	NS	-1.29	-0.70	-0.33	0.72	0.52	ND
4 KNOLDIAMETER IN	+	-	-	ND	0.05	0.961	NS	1.83	-0.35	-0.95	1.04	0.40	ND
5 KNOLHOOGTE IN MM	+	-	-	ND	-1.04	0.327	NS	0.51	-2.07	-0.37	1.31	0.32	ND
6 BLD.STL.+BLD.SCH	-	+	+	ND	0.65	0.536	NS	-0.59	0.74	1.86	1.06	0.39	ND
7 KNOLH/KNOLDIAM	-	-	+	ND	-1.17	0.277	NS	-0.91	-1.72	1.75	1.62	0.26	ND
8 KNOLDIAM/KNOLH	+	+	-	ND	1.15	0.282	NS	0.82	1.59	-1.69	1.66	0.25	ND

KROOT 1985, 1986, 1987 20-MAY-88

(8) Geerhoek Vak: G 4

COMPARISONS BETWEEN 1 MOBILE AND 6 KRT 40
T VALUES POSITIVE IF MOBILE LARGER THAN KRT 40

	SIGNIFICANCE LEVELS YEARS 85	86	87		COMBINED ANALYSIS T	PROB	SIG	T VALUES YEARS 85	86	87	F3	P(F3)	
1 BLADSTEELLENGTE	-	+	+	ND	0.39	0.708	NS	-1.20	1.08	1.81	2.09	0.19	ND
2 BLADSCHIJFLENGTE	+	+	+	ND	2.09	0.070	NS	0.82	1.06	1.41	0.02	0.98	ND
3 BLADSCHIJFBREEDT	-	-	-	ND	-3.97	0.004	**	-1.96	-1.32	-0.81	1.25	0.34	D
4 KNOLDIAMETER IN	+	+	-	ND	0.61	0.561	NS	1.07	1.98	-1.19	1.55	0.27	ND
5 KNOLHOOGTE IN MM	+	+	-	ND	0.36	0.729	NS	0.95	0.13	-0.16	0.14	0.87	ND
6 BLD.STL.+BLD.SCH	-	+	+5	ND	1.09	0.306	NS	-0.64	1.47	2.21	1.59	0.26	ND
7 KNOLH/KNOLDIAM	+	-	+5	ND	-0.10	0.925	NS	0.00	-1.09	2.62	1.20	0.35	ND
8 KNOLDIAM/KNOLH	-	+	-1	ND	0.16	0.873	NS	-0.20	1.14	-2.96	1.51	0.28	ND

KROOT 1985, 1986, 1987 20-MAY-88

(9) Geerhoek Vak: G 4

COMPARISONS BETWEEN 1 MOBILE AND 4 MONORONDO
T VALUES POSITIVE IF MOBILE LARGER THAN MONORONDO

	SIGNIFICANCE LEVELS YEARS 85	86	87		COMBINED ANALYSIS T	PROB	SIG	T VALUES YEARS 85	86	87	F3	P(F3)	
1 BLADSTEELLENGTE	-1	-	-	ND	-4.10	0.003	**	-3.52	-2.03	-1.82	2.56	0.14	D
2 BLADSCHIJFLENGTE	-	-	-	ND	-1.90	0.094	NS	-0.81	-1.40	-0.48	0.52	0.62	ND
3 BLADSCHIJFBREEDT	-1	-5	-1	D	-8.74	0.000	***	-2.91	-2.88	-3.63	0.23	0.80	D
4 KNOLDIAMETER IN	+1	+1	+	D	3.34	0.010	*	3.74	4.01	0.68	1.41	0.30	D
5 KNOLHOOGTE IN MM	+5	-	-	ND	0.74	0.482	NS	2.63	-0.04	-0.55	1.25	0.34	ND
6 BLD.STL.+BLD.SCH	-1	-5	-	ND	-4.03	0.004	**	-2.99	-2.45	-1.67	1.89	0.21	D
7 KNOLH/KNOLDIAM	-	-5	-1	ND	-2.63	0.030	*	-0.36	-2.81	-3.06	1.90	0.21	D
8 KNOLDIAM/KNOLH	+	+5	+1	ND	2.47	0.039	*	0.20	2.39	3.38	2.10	0.18	D

(10) KROOT 1985, 1986, 1987 20-MAY-88

Geerhoek Vak: G 4

COMPARISONS BETWEEN 2 MONOTOP AND 3 MONOPOLY
T VALUES POSITIVE IF MONOTOP LARGER THAN MONOPOLY

	Significance levels, years 85	86	87		Combined analysis T	PROB	SIG	T values, years 85	86	87	F3	P(F3)	
1 BLADSTEELLENGTE	-	-1	-5	ND	-3.91	0.004	**	-1.51	-3.79	-2.71	0.65	0.55	D
2 BLADSCHIJFLENGTE	-	-	-5	ND	-2.87	0.021	*	-0.25	-1.93	-2.62	1.34	0.32	D
3 BLADSCHIJFBREEDT	+	-	+	ND	0.86	0.416	NS	0.64	-0.25	0.70	0.73	0.52	ND
4 KNOLDIAMETER IN	+	-5	-	ND	-0.89	0.399	NS	1.26	-2.77	-0.44	1.91	0.21	ND
5 KNOLHOOGTE IN MM	-	-1	-	ND	-1.93	0.090	NS	-0.37	-3.27	-0.19	2.60	0.13	ND
6 BLD.STL.+BLD.SCH	-	-1	-5	ND	-4.10	0.003	**	-1.25	-4.22	-2.97	0.98	0.58	D
7 KNOLH/KNOLDIAM	-	-	+	ND	-1.36	0.210	NS	-1.27	-1.41	0.87	0.98	0.58	ND
8 KNOLDIAM/KNOLH	+	+	-	ND	1.15	0.282	NS	1.22	1.14	-0.84	0.76	0.50	ND

(11) KROOT 1985, 1986, 1987 20-MAY-88

Geerhoek Vak: G 4

COMPARISONS BETWEEN 2 MONOTOP AND 6 KRT 40
T VALUES POSITIVE IF MONOTOP LARGER THAN KRT 40

	Significance levels, years 85	86	87		Combined analysis T	PROB	SIG	T values, years 85	86	87	F3	P(F3)	
1 BLADSTEELLENGTE	-	-5	-5	ND	-3.26	0.012	*	-1.51	-2.78	-2.29	0.17	0.84	D
2 BLADSCHIJFLENGTE	-	-5	-5	ND	-3.05	0.016	*	-0.40	-2.17	-2.37	1.33	0.32	D
3 BLADSCHIJFBREEDT	-	-	+	ND	-0.86	0.416	NS	-0.04	-0.87	0.21	1.11	0.38	ND
4 KNOLDIAMETER IN	+	-	-	ND	-0.34	0.745	NS	0.49	-0.43	-0.68	0.21	0.81	ND
5 KNOLHOOGTE IN MM	+	-	+	ND	-0.53	0.612	NS	0.07	-1.08	0.03	0.34	0.72	ND
6 BLD.STL.+BLD.SCH	-	-1	-5	ND	-3.65	0.006	**	-1.30	-3.49	-2.62	0.45	0.65	D
7 KNOLH/KNOLDIAM	-	-	+	ND	-0.29	0.778	NS	-0.36	-0.78	1.75	0.60	0.58	ND
8 KNOLDIAM/KNOLH	+	+	-	ND	0.16	0.873	NS	0.20	0.68	-2.11	0.62	0.57	ND

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KROOT 1985, 1986, 1987 20-MAY-88

Geerhoek Vak: G 4

COMPARISONS BETWEEN 3 MONOPOLY AND 4 MONORONDO
T VALUES POSITIVE IF MONOPOLY LARGER THAN MONORONDO

	SIGNIFICANCE LEVELS YEARS 85	86	87		COMBINED ANALYSIS T	PROB	SIG	T VALUES YEARS 85	86	87	F3	P(F3)	
1 BLADSTEELLENGTE	-5	-	-1	ND	-3.84	0.005	**	-2.31	-2.09	-3.21	0.26	0.78	D
2 BLADSCHIJFLENGTE	-	-5	-	ND	-4.16	0.003	**	-1.77	-2.71	-1.63	1.20	0.35	D
3 BLADSCHIJFBREEDT	-	-5	-1	ND	-6.49	0.000	***	-1.63	-2.18	-3.31	0.83	0.53	D
4 KNOLDIAMETER IN	+	+1	+	ND	3.29	0.011	*	1.91	4.37	1.63	1.07	0.39	D
5 KNOLHOOGTE IN MM	+5	+	-	ND	1.78	0.113	NS	2.11	2.03	-0.18	1.06	0.39	ND
6 BLD.STL.+BLD.SCH	-5	-1	-1	D	-4.68	0.002	**	-2.40	-3.19	-3.53	0.12	0.89	D
7 KNOLH/KNOLDIAM	+	-	-1	ND	-1.46	0.182	NS	0.55	-1.09	-4.81	1.48	0.28	ND
8 KNOLDIAM/KNOLH	-	+	+1	ND	1.32	0.224	NS	-0.61	0.80	5.07	1.19	0.35	ND

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KROOT 1985, 1986, 1987 20-MAY-88

Geerhoek Vak: G 4

COMPARISONS BETWEEN 6 KRT 40 AND 4 MONORONDO
T VALUES POSITIVE IF KRT 40 LARGER THAN MONORONDO

	SIGNIFICANCE LEVELS YEARS 85	86	87		COMBINED ANALYSIS T	PROB	SIG	T VALUES YEARS 85	86	87	F3	P(F3)	
1 BLADSTEELLENGTE	-5	-1	-1	D	-4.49	0.002	**	-2.31	-3.11	-3.63	0.03	0.97	D
2 BLADSCHIJFLENGTE	-	-5	-	ND	-3.99	0.004	**	-1.62	-2.46	-1.89	0.70	0.53	D
3 BLADSCHIJFBREEDT	-	-	-5	ND	-4.77	0.001	**	-0.95	-1.56	-2.82	1.15	0.37	D
4 KNOLDIAMETER IN	+5	+	+	ND	2.74	0.026	*	2.67	2.03	1.86	0.02	0.98	D
5 KNOLHOOGTE IN MM	+	-	-	ND	0.38	0.715	NS	1.67	-0.16	-0.40	0.57	0.59	ND
6 BLD.STL.+BLD.SCH	-5	-1	-1	D	-5.13	0.001	***	-2.35	-3.92	-3.87	0.10	0.91	D
7 KNOLH/KNOLDIAM	-	-	-1	ND	-2.53	0.035	*	-0.36	-1.72	-5.69	0.98	0.58	D
8 KNOLDIAM/KNOLH	+	+	+1	ND	2.31	0.050	*	0.41	1.25	6.33	0.90	0.55	D

(14) KROOT 1985, 1986, 1987 20-MAY-88

Geerhoek Vak: G 4

COMPARISONS BETWEEN 2 MONOTOP AND 4 MONORONDO
T VALUES POSITIVE IF MONOTOP LARGER THAN MONORONDO

	SIGNIFICANCE LEVELS YEARS 85	86	87		COMBINED ANALYSIS T	PROB	SIG	T VALUES YEARS 85	86	87	F3	P(F3)	
• 1 BLADSTEELLENGTE	-1	-1	-1	D	-7.75	0.000	***	-3.82	-5.88	-5.92	0.27	0.77	D
2 BLADSCHIJFLENGTE	-	-1	-1	D	-7.03	0.000	***	-2.02	-4.63	-4.25	3.01	0.11	D
3 BLADSCHIJFBREEDT	-	-5	-5	ND	-5.63	0.000	***	-0.99	-2.43	-2.61	2.40	0.15	D
4 KNOLDIAMETER IN	+1	+	+	ND	2.40	0.043	*	3.17	1.60	1.18	0.29	0.76	D
5 KNOLHOOGTE IN MM	+	-	-	ND	-0.15	0.885	NS	1.74	-1.24	-0.37	1.30	0.33	ND
6 BLD.STL.+BLD.SCH	-1	-1	-1	D	-8.78	0.000	***	-3.65	-7.41	-6.50	0.85	0.53	D
7 KNOLH/KNOLDIAM	-	-5	-1	ND	-2.82	0.022	*	-0.73	-2.50	-3.94	1.03	0.40	D
8 KNOLDIAM/KNOLH	+	+	+1	ND	2.47	0.039	*	0.61	1.93	4.22	1.00	0.59	D

(15) KROOT 1985, 1986, 1987 20-MAY-88

Geerhoek Vak: G 4

COMPARISONS BETWEEN 3 MONOPOLY AND 6 KRT 40
T VALUES POSITIVE IF MONOPOLY LARGER THAN KRT 40

	SIGNIFICANCE LEVELS YEARS 85	86	87		COMBINED ANALYSIS T	PROB	SIG	T VALUES YEARS 85	86	87	F3	P(F3)	
1 BLADSTEELLENGTE	+	+	+	ND	0.65	0.532	NS	0.00	1.02	0.42	0.19	0.83	ND
2 BLADSCHIJFLENGTE	-	-	+	ND	-0.18	0.864	NS	-0.14	-0.25	0.26	0.08	0.93	ND
3 BLADSCHIJFBREEDT	-	-	-	ND	-1.71	0.125	NS	-0.68	-0.62	-0.49	0.10	0.91	ND
4 KNOLDIAMETER IN	-	+5	-	ND	0.56	0.594	NS	-0.76	2.33	-0.24	1.35	0.31	ND
5 KNOLHOOGTE IN MM	+	+5	+	ND	1.40	0.198	NS	0.44	2.19	0.22	1.05	0.39	ND
6 BLD.STL.+BLD.SCH	-	+	+	ND	0.45	0.667	NS	-0.05	0.72	0.34	0.11	0.90	ND
7 KNOLH/KNOLDIAM	+	+	+	ND	1.07	0.316	NS	0.91	0.62	0.87	0.07	0.94	ND
8 KNOLDIAM/KNOLH	-	-	-	ND	-0.99	0.352	NS	-1.02	-0.45	-1.27	0.02	0.98	ND

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Geerhoek Vak: G 4

	1 BLADSTEE LLENGTE	2 BLADSCHI JFLENGTE	3 BLADSCHI JFBREEDT	4 KNOLDIAM ETER IN	5 KNOLHOOG TE IN MM	6 BLD.STL. +BLD.SCH	7 KNOLH/KN OLDIAM	8 KNOLDIAM /KNOLH
1 MOBILE	20.400	19.230	10.930	74.750	71.250	39.630	0.950	1.060
2 MONOTOP	19.850	18.220	11.980	73.180	68.330	38.070	0.930	1.080
3 MONOPOLY	22.580	18.430	11.630	69.720	69.550	41.020	1.000	1.020
4 KRT 40	22.580	18.550	12.000	71.820	68.100	41.130	0.950	1.070
5 MONORONDO	26.770	19.900	12.520	64.480	62.570	46.670	0.970	1.050
WITHIN SE	1.280	0.588	0.386	1.943	2.336	1.664	0.039	0.035
LSD AT 5%	3.775	1.736	1.139	5.732	6.890	4.908	0.115	0.103
LSD AT 1%	5.149	2.368	1.554	7.817	9.397	6.694	0.157	0.140
D.F.	20	20	20	20	20	20	20	20

Results of the Mod. Joined Regression Analysis

	1	2	3	4	5	6	7	8
MJRA SLOPE	1.022	0.693	0.889	0.965	0.752	0.898	0.407	0.291
SLOPE SE	0.275	0.133	0.200	0.367	0.708	0.222	0.295	0.256

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Geerhoek Vak: G 4

	1 BLADSTEE LLENGTE	2 BLADSCHI JFLENGTE	3 BLADSCHI JFBREEDT	4 KNOLDIAM ETER IN	5 KNOLHOOG TE IN MM	6 BLD.STL. +BLD.SCH	7 KNOLH/KN OLDIAM	8 KNOLDIAM /KNOLH
1 MOBILE	23.580	19.900	12.680	75.830	69.080	43.480	0.920	1.130
2 MONOTOP	18.650	17.300	12.970	68.420	63.500	35.950	0.940	1.090
3 MONOPOLY	23.500	18.850	13.130	76.920	78.670	42.350	1.030	0.990
4 KRT 40	22.200	19.050	13.530	69.750	68.500	41.250	0.990	1.030
5 MONORONDO	26.170	21.030	14.530	63.500	69.250	47.200	1.100	0.920
WITHIN SE	0.904	0.569	0.454	2.172	3.278	1.073	0.045	0.062
LSD AT 5%	2.740	1.727	1.377	6.589	9.944	3.256	0.138	0.188
LSD AT 1%	3.803	2.397	1.910	9.145	13.801	4.518	0.191	0.261
D.F.	14	14	14	14	14	14	14	14

Results of the Mod. Joined Regression Analysis

	1	2	3	4	5	6	7	8
MJRA SLOPE	1.104	1.454	1.139	1.447	(2.250)	1.211	1.691	1.752
SLOPE SE	0.151	0.053	0.153	0.405	0.520	0.114	0.334	0.432

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Geerhoek Vak: G 4

	1 BLADSTEE LLENGTE	2 BLADSCHI JFLENGTE	3 BLADSCHI JFBREEDT	4 KNOLDIAM ETER IN	5 KNOLHOOG TE IN MM	6 BLD.STL. +BLD.SCH	7 KNOLH/KN OLDIAM	8 KNOLDIAM /KNOLH
1 MOBILE	22.510	18.400	13.180	58.110	56.330	40.910	0.990	1.050
2 MONOTOP	18.390	16.500	13.620	60.000	57.000	34.890	0.970	1.070
3 MONOPOLY	21.110	17.820	13.320	61.670	57.670	38.590	0.950	1.090
4 KRT 40	20.690	17.690	13.530	62.560	56.890	38.160	0.930	1.120
5 MONORONDO	24.340	18.640	14.740	55.560	58.330	42.990	1.060	0.970
WITHIN SE	0.711	0.356	0.304	2.654	2.551	0.882	0.016	0.017
LSD AT 5%	2.155	1.079	0.922	8.051	7.740	2.674	0.049	0.050
LSD AT 1%	2.991	1.497	1.280	11.174	10.742	3.711	0.068	0.069
D.F.	14	14	14	14	14	14	14	14

Results of the Mod. Joined Regression Analysis

MJRA SLOPE	0.873	0.853	0.972	0.588	-0.002	0.891	0.901	0.957
SLOPE SE	0.157	0.123	0.149	0.328	0.196	0.131	0.488	0.512

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VARIETY MEANS OVER YEARS

	1 BLADSTEE LLENGTE	2 BLADSCHI JFLENGTE	3 BLADSCHI JFBREEDT	4 KNOLDIAM ETER IN	5 KNOLHOOG TE IN MM	6 BLD.STL. +BLD.SCH	7 KNOLH/KN OLDIAM	8 KNOLDIAM /KNOLH
1 MOBILE	22.163	19.177	12.263	69.563	65.553	41.340	0.953	1.080
2 MONOTOP	18.963	17.340	12.857	67.200	62.943	36.303	0.947	1.080
3 MONOPOLY	22.397	18.367	12.693	69.437	68.630	40.653	0.993	1.033
4 KRT 40	21.823	18.430	13.020	68.043	64.497	40.180	0.957	1.073
5 MONORONDO	25.760	19.857	13.930	61.180	63.383	45.620	1.043	0.980
YEAR MS	7.995	8.124	14.998	633.634	689.679	35.012	0.005	0.003
VARIETY MS	52.491	8.048	3.401	106.814	46.305	99.333	0.015	0.017
VAR.YEAR MS	4.295	0.193	0.194	28.963	25.009	5.273	0.004	0.006
F1 RATIO	12.220	41.759	17.566	3.688	1.851	18.837	3.431	2.919
VAR.REP MS	3.204	0.827	0.447	15.012	21.917	5.149	0.004	0.005
F2 RATIO	1.341	0.233	0.433	1.929	1.141	1.024	1.098	1.129
BETWEEN SE	0.691	0.146	0.147	1.794	1.667	0.765	0.022	0.025
WITHIN SE	0.597	0.303	0.223	1.292	1.561	0.756	0.021	0.024

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(20) Geerhoek Vak: G 4

COMPARISONS BETWEEN 1 MOBILE AND 3 MONOPOLY
T VALUES POSITIVE IF MOBILE LARGER THAN MONOPOLY
NB: WITH USE OF MODIFIED JOINED REGRESSION ANALYSIS

	SIGNIFICANCE LEVELS YEARS 85	86	87		COMBINED ANALYSIS T	PROB	SIG	T VALUES YEARS 85	86	87	F3	P(F3)	
1 BLADSTEELLENGTE	-	+	+	ND	-0.24	0.819	NS	-1.20	0.06	1.39	1.14	0.37	ND
2 BLADSCHIJFLENGTE	+	+	+	ND	3.91	0.008	**	0.96	1.30	1.15	0.43	0.67	D
3 BLADSCHIJFBREEDT	-	-	-	ND	-2.07	0.084	NS	-1.28	-0.70	-0.33	0.61	0.57	ND
4 KNOLDIAMETER IN	+	-	-	ND	0.05	0.962	NS	1.83	-0.35	-0.95	1.01	0.41	ND
5 KNOLHOOGTE IN MM	+	-	-	ND	-1.31	0.240	NS	0.51	-2.07	-0.37	2.05	0.19	ND
6 BLD.STL.+BLD.SCH	-	+	+	ND	0.63	0.549	NS	-0.59	0.74	1.86	1.02	0.40	ND
7 KNOLH/KNOLDIAM	-	-	+	ND	-1.29	0.243	NS	-0.91	-1.72	1.75	1.99	0.20	ND
8 KNOLDIAM/KNOLH	+	+	-	ND	1.30	0.241	NS	0.82	1.59	-1.69	2.10	0.18	ND

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(21) Geerhoek Vak: G 4

COMPARISONS BETWEEN 1 MOBILE AND 6 KRT 40
T VALUES POSITIVE IF MOBILE LARGER THAN KRT 40
NB: WITH USE OF MODIFIED JOINED REGRESSION ANALYSIS

	SIGNIFICANCE LEVELS YEARS 85	86	87		COMBINED ANALYSIS T	PROB	SIG	T VALUES YEARS 85	86	87	F3	P(F3)	
1 BLADSTEELLENGTE	-	+	+	ND	0.35	0.740	NS	-1.20	1.08	1.81	1.68	0.25	ND
2 BLADSCHIJFLENGTE	+	+	+	ND	3.61	0.011	*	0.82	1.06	1.41	0.06	0.94	D
3 BLADSCHIJFBREEDT	-	-	-	ND	-3.65	0.011	*	-1.96	-1.32	-0.81	1.05	0.39	D
4 KNOLDIAMETER IN	+	+	-	ND	0.60	0.571	NS	1.07	1.98	-1.19	1.51	0.28	ND
5 KNOLHOOGTE IN MM	+	+	-	ND	0.45	0.670	NS	0.95	0.13	-0.16	0.22	0.81	ND
6 BLD.STL.+BLD.SCH	-	+	+5	ND	1.07	0.325	NS	-0.64	1.47	2.21	1.53	0.27	ND
7 KNOLH/KNOLDIAM	+	-	+5	ND	-0.11	0.918	NS	0.00	-1.09	2.62	1.48	0.28	ND
8 KNOLDIAM/KNOLH	-	+	-1	ND	0.19	0.859	NS	-0.20	1.14	-2.96	1.92	0.21	ND

(22) KROOT   1985, 1986, 1987   20-MAY-88

Geerhoek Vak: G 4

COMPARISONS BETWEEN 1 MOBILE AND 4 MONORONDO
T VALUES POSITIVE IF MOBILE LARGER THAN MONORONDO
NB: WITH USE OF MODIFIED JOINED REGRESSION ANALYSIS

	SIGNIFICANCE LEVELS YEARS 85	86	87		COMBINED ANALYSIS T	PROB	SIG	T VALUES YEARS 85	86	87	F3	P(F3)	
1 BLADSTEELLENGTE	-1	-	-	ND	-3.68	0.010	*	-3.52	-2.03	-1.82	2.06	0.19	D
2 BLADSCHIJFLENGTE	-	-	-	ND	-3.29	0.017	*	-0.81	-1.40	-0.48	1.54	0.27	D
3 BLADSCHIJFBREEDT	-1	-5	-1	D	-8.04	0.000	***	-2.91	-2.88	-3.63	0.20	0.83	D
4 KNOLDIAMETER IN	+1	+1	+	D	3.30	0.016	*	3.74	4.01	0.68	1.38	0.31	D
5 KNOLHOOGTE IN MM	+5	-	-	ND	0.92	0.393	NS	2.63	-0.04	-0.55	1.96	0.20	ND
6 BLD.STL.+BLD.SCH	-1	-5	-	ND	-3.95	0.008	**	-2.99	-2.45	-1.67	1.82	0.22	D
7 KNOLH/KNOLDIAM	-	-5	-1	ND	-2.91	0.027	*	-0.36	-2.81	-3.06	2.34	0.16	D
8 KNOLDIAM/KNOLH	+	+5	+1	ND	2.79	0.032	*	0.20	2.39	3.38	2.67	0.13	D

(23) KROOT   1985, 1986, 1987   20-MAY-88

Geerhoek Vak: G 4

COMPARISONS BETWEEN 2 MONOTOP AND 6 KRT 40
T VALUES POSITIVE IF MONOTOP LARGER THAN KRT 40
NB: WITH USE OF MODIFIED JOINED REGRESSION ANALYSIS

	SIGNIFICANCE LEVELS YEARS 85	86	87		COMBINED ANALYSIS T	PROB	SIG	T VALUES YEARS 85	86	87	F3	P(F3)	
1 BLADSTEELLENGTE	-	-5	-5	ND	-2.93	0.026	*	-1.51	-2.78	-2.29	0.14	0.87	D
2 BLADSCHIJFLENGTE	-	-5	-5	ND	-5.27	0.002	**	-0.40	-2.17	-2.37	3.98	0.06	D
3 BLADSCHIJFBREEDT	-	-	+	ND	-0.79	0.461	NS	-0.04	-0.87	0.21	0.94	0.57	ND
4 KNOLDIAMETER IN	+	-	-	ND	-0.33	0.751	NS	0.49	-0.43	-0.68	0.21	0.82	ND
5 KNOLHOOGTE IN MM	+	-	+	ND	-0.66	0.534	NS	0.07	-1.08	0.03	0.53	0.61	ND
6 BLD.STL.+BLD.SCH	-	-1	-5	ND	-3.58	0.012	*	-1.30	-3.49	-2.62	0.44	0.67	D
7 KNOLH/KNOLDIAM	-	-	+	ND	-0.32	0.757	NS	-0.36	-0.78	1.75	0.73	0.51	ND
8 KNOLDIAM/KNOLH	+	+	-	ND	0.19	0.859	NS	0.20	0.68	-2.11	0.78	0.51	ND

(24) KROOT   1985, 1986, 1987   20-MAY-88

Geerhoek Vak: G 4

COMPARISONS BETWEEN 2 MONOTOP AND 4 MONORONDO
T VALUES POSITIVE IF MONOTOP LARGER THAN MONORONDO
NB: WITH USE OF MODIFIED JOINED REGRESSION ANALYSIS

	SIGNIFICANCE LEVELS YEARS				COMBINED ANALYSIS			T VALUES YEARS			F3	P(F3)	
	85	86	87		T	PROB	SIG	85	86	87			
1 BLADSTEELLENGTE	-1	-1	-1	D	-6.96	0.000	***	-3.82	-5.88	-5.92	0.22	0.81	D
2 BLADSCHIJFLENGTE	-	-1	-1	D	-12.16	0.000	***	-2.02	-4.63	-4.25	9.01	0.01	D
3 BLADSCHIJFBREEDT	-	-5	-5	ND	-5.17	0.002	**	-0.99	-2.43	-2.61	2.03	0.19	D
4 KNOLDIAMETER IN	+1	+	+	ND	2.37	0.055	NS	3.17	1.60	1.18	0.28	0.76	ND
5 KNOLHOOGTE IN MM	+	-	-	ND	-0.19	0.858	NS	1.74	-1.24	-0.37	2.02	0.19	ND
6 BLD.STL.+BLD.SCH	-1	-1	-1	D	-8.61	0.000	***	-3.65	-7.41	-6.50	0.82	0.52	D
7 KNOLH/KNOLDIAM	-	-5	-1	ND	-3.13	0.020	*	-0.73	-2.50	-3.94	1.27	0.33	D
8 KNOLDIAM/KNOLH	+	+	+1	ND	2.79	0.032	*	0.61	1.93	4.22	1.27	0.33	D

(25) KROOT   1985, 1986, 1987   20-MAY-88

Geerhoek Vak: G 4

COMPARISONS BETWEEN 3 MONOPOLY AND 4 MONORONDO
T VALUES POSITIVE IF MONOPOLY LARGER THAN MONORONDO
NB: WITH USE OF MODIFIED JOINED REGRESSION ANALYSIS

	SIGNIFICANCE LEVELS YEARS				COMBINED ANALYSIS			T VALUES YEARS			F3	P(F3)	
	85	86	87		T	PROB	SIG	85	86	87			
1 BLADSTEELLENGTE	-5	-	-1	ND	-3.44	0.014	*	-2.31	-2.09	-3.21	0.21	0.82	D
2 BLADSCHIJFLENGTE	-	-5	-	ND	-7.20	0.000	***	-1.77	-2.71	-1.63	3.60	0.08	D
3 BLADSCHIJFBREEDT	-	-5	-1	ND	-5.96	0.001	***	-1.63	-2.18	-3.31	0.70	0.53	D
4 KNOLDIAMETER IN	+	+1	+	ND	3.25	0.017	*	1.91	4.37	1.63	1.05	0.40	D
5 KNOLHOOGTE IN MM	+5	+	-	ND	2.23	0.068	NS	2.11	2.03	-0.18	1.66	0.25	ND
6 BLD.STL.+BLD.SCH	-5	-1	-1	D	-4.59	0.004	**	-2.40	-3.19	-3.53	0.11	0.89	D
7 KNOLH/KNOLDIAM	+	-	-1	ND	-1.62	0.157	NS	0.55	-1.09	-4.81	1.82	0.22	ND
8 KNOLDIAM/KNOLH	-	+	+1	ND	1.49	0.188	NS	-0.61	0.80	5.07	1.51	0.28	ND

(26) KROOT — 1985, 1986 — 20-MAY-88

Geerhoek Vak: G 4

COMPARISONS BETWEEN 6 KRT 40 AND 4 MONORONDO
T VALUES POSITIVE IF KRT 40 LARGER THAN MONORONDO

		SIGNIFICANCE LEVELS YEARS 85	86		COMBINED ANALYSIS T	PROB	SIG	T VALUES YEARS 85	86	F3	P(F3)	
1	BLADSTEELLENGTE	-5	-1	ND	-3.18	0.011	*	-2.31	-3.11	0.01	0.93	D
2	BLADSCHIJFLENGTE	-	-5	ND	-1.88	0.093	NS	-1.62	-2.46	0.13	0.73	ND
3	BLADSCHIJFBREEDT	-	-	ND	-1.14	0.284	NS	-0.95	-1.56	0.13	0.73	ND
4	KNOLDIAMETER IN	+5	+	ND	2.88	0.018	*	2.67	2.03	0.05	0.82	D
5	KNOLHOOGTE IN MM	+	-	ND	0.56	0.592	NS	1.67	-0.16	0.53	0.51	ND
6	BLD.STL.+BLD.SCH	-5	-1	ND	-2.82	0.020	*	-2.35	-3.92	0.01	0.92	D
7	KNOLH/KNOLDIAM	-	-	ND	-1.31	0.223	NS	-0.36	-1.72	0.82	0.61	ND
8	KNOLDIAM/KNOLH	+	+	ND	1.06	0.315	NS	0.41	1.25	0.54	0.51	ND

(27) KROOT — 1985, 1986 — 20-MAY-88

Geerhoek Vak: G 4

COMPARISONS BETWEEN 6 KRT 40 AND 4 MONORONDO
T VALUES POSITIVE IF KRT 40 LARGER THAN MONORONDO
NB: WITH USE OF MODIFIED JOINED REGRESSION ANALYSIS

		SIGNIFICANCE LEVELS YEARS 85	86		COMBINED ANALYSIS T	PROB	SIG	T VALUES YEARS 85	86	F3	P(F3)	
1	BLADSTEELLENGTE	-5	-1	ND	-3.01	0.017	*	-2.31	-3.11	0.01	0.94	D
2	BLADSCHIJFLENGTE	-	-5	ND	-1.93	0.089	NS	-1.62	-2.46	0.13	0.72	ND
3	BLADSCHIJFBREEDT	-	-	ND	-1.73	0.122	NS	-0.95	-1.56	0.30	0.60	ND
4	KNOLDIAMETER IN	+5	+	ND	2.85	0.022	*	2.67	2.03	0.05	0.82	D
5	KNOLHOOGTE IN MM	+	-	ND	0.54	0.604	NS	1.67	-0.16	0.50	0.50	ND
6	BLD.STL.+BLD.SCH	-5	-1	ND	-2.76	0.025	*	-2.35	-3.92	0.01	0.92	D
7	KNOLH/KNOLDIAM	-	-	ND	-1.24	0.251	NS	-0.36	-1.72	0.74	0.58	ND
8	KNOLDIAM/KNOLH	+	+	ND	1.05	0.326	NS	0.41	1.25	0.52	0.51	ND

(28) KROOT 1986, 1987 20-MAY-88

STERREBOS 868

COMPARISONS BETWEEN 6 KRT 40 AND 4 MONORONDO
T VALUES POSITIVE IF KRT 40 LARGER THAN MONORONDO

	SIGNIFICANCE LEVELS YEARS 86	87		COMBINED ANALYSIS T	PROB	SIG	T VALUES YEARS 86	87	F3	P(F3)	
1 BLADSTEELLENGTE	-1	-1	D	-3.72	0.010	**	-3.11	-3.63	0.02	0.88	D
2 BLADSCHIJFLENGTE	-5	-	ND	-2.01	0.091	NS	-2.46	-1.89	0.50	0.51	ND
3 BLADSCHIJFBREEDT	-	-5	ND	-2.35	0.057	NS	-1.56	-2.82	0.05	0.82	ND
4 KNOLHOOGTE IN MM	-	-	ND	-0.33	0.749	NS	-0.16	-0.40	0.01	0.92	ND
5 KNOLDIAMETER IN	+	+	ND	2.26	0.064	NS	2.03	1.86	0.02	0.90	ND
6 BLD.STL.+BLD.SCH	-1	-1	D	-3.20	0.019	*	-3.92	-3.87	0.11	0.75	D
7 KNOLH/KNOLDIAM	-	-1	ND	-3.03	0.023	*	-1.72	-5.69	0.06	0.80	D
8 KNOLDIAM/KNOLH	+	+1	ND	2.76	0.033	*	1.25	6.33	0.18	0.69	D

(29) KROOT 1986, 1987 20-MAY-88

STERREBOS 868

COMPARISONS BETWEEN 6 KRT 40 AND 4 MONORONDO
T VALUES POSITIVE IF KRT 40 LARGER THAN MONORONDO
NB: WITH USE OF MODIFIED JOINED REGRESSION ANALYSIS

	SIGNIFICANCE LEVELS YEARS 86	87		COMBINED ANALYSIS T	PROB	SIG	T VALUES YEARS 86	87	F3	P(F3)	
1 BLADSTEELLENGTE	-1	-1	D	-4.16	0.009	**	-3.11	-3.63	0.03	0.86	D
2 BLADSCHIJFLENGTE	-5	-	ND	-2.24	0.075	NS	-2.46	-1.89	0.62	0.54	ND
3 BLADSCHIJFBREEDT	-	-5	ND	-3.45	0.018	*	-1.56	-2.82	0.11	0.75	D
4 KNOLHOOGTE IN MM	-	-	ND	-0.37	0.726	NS	-0.16	-0.40	0.01	0.91	ND
5 KNOLDIAMETER IN	+	+	ND	2.34	0.067	NS	2.03	1.86	0.02	0.89	ND
6 BLD.STL.+BLD.SCH	-1	-1	D	-3.64	0.015	*	-3.92	-3.87	0.14	0.72	D
7 KNOLH/KNOLDIAM	-	-1	ND	-2.99	0.030	*	-1.72	-5.69	0.06	0.81	D
8 KNOLDIAM/KNOLH	+	+1	ND	2.73	0.041	*	1.25	6.33	0.18	0.69	D

(30) KROOT 1986, 1987 20-MAY-88

STERREBOS 868

COMPARISONS BETWEEN 8 MONA AND 4 MONORONDO
T VALUES POSITIVE IF MONA LARGER THAN MONORONDO

	SIGNIFICANCE LEVELS YEARS 86	87		COMBINED ANALYSIS T	PROB	SIG	T VALUES YEARS 86	87	F3	P(F3)	
1 BLADSTEELLENGTE	+	-5	ND	-1.29	0.245	NS	0.06	-2.71	1.87	0.22	ND
2 BLADSCHIJFLENGTE	-	-1	ND	-1.96	0.098	NS	-1.13	-3.86	0.50	0.51	ND
3 BLADSCHIJFBREEDT	-	-5	ND	-1.63	0.154	NS	-0.59	-2.68	0.67	0.55	ND
4 KNOLHOOGTE IN MM	-5	-1	ND	-4.05	0.007	**	-2.77	-3.79	0.02	0.90	D
5 KNOLDIAMETER IN	+	-	ND	0.93	0.388	NS	1.95	-0.15	1.26	0.31	ND
6 BLD.STL.+BLD.SCH	-	-1	ND	-1.63	0.153	NS	-0.55	-3.75	1.30	0.30	ND
7 KNOLH/KNOLDIAM	-1	-1	D	-6.57	0.001	***	-4.38	-10.50	0.26	0.63	D
8 KNOLDIAM/KNOLH	+1	+1	D	6.48	0.001	***	3.75	11.83	0.28	0.62	D

(31) KROOT 1986, 1987 20-MAY-88

STERREBOS 868

COMPARISONS BETWEEN 8 MONA AND 4 MONORONDO
T VALUES POSITIVE IF MONA LARGER THAN MONORONDO
NB: WITH USE OF MODIFIED JOINED REGRESSION ANALYSIS

	SIGNIFICANCE LEVELS YEARS 86	87		COMBINED ANALYSIS T	PROB	SIG	T VALUES YEARS 86	87	F3	P(F3)	
1 BLADSTEELLENGTE	+	-5	ND	-1.44	0.209	NS	0.06	-2.71	2.34	0.18	ND
2 BLADSCHIJFLENGTE	-	-1	ND	-2.18	0.081	NS	-1.13	-3.86	0.62	0.54	ND
3 BLADSCHIJFBREEDT	-	-5	ND	-2.39	0.063	NS	-0.59	-2.68	1.44	0.27	ND
4 KNOLHOOGTE IN MM	-5	-1	ND	-4.48	0.006	**	-2.77	-3.79	0.02	0.89	D
5 KNOLDIAMETER IN	+	-	ND	0.96	0.382	NS	1.95	-0.15	1.34	0.29	ND
6 BLD.STL.+BLD.SCH	-	-1	ND	-1.86	0.122	NS	-0.55	-3.75	1.69	0.24	ND
7 KNOLH/KNOLDIAM	-1	-1	D	-6.48	0.001	**	-4.38	-10.50	0.25	0.64	D
8 KNOLDIAM/KNOLH	+1	+1	D	6.41	0.001	**	3.75	11.83	0.28	0.62	D

Summary of decisions in red beet

Comparisons of the conclusions from 2/3, or 2/2 and COY at 1%.

I: 5 cultivars ----> 10 comparisons between pairs;
3 years : 85, 86 and 87.
8 characters

B

2/3 -1%

COY-1%:		D	ND	
	D	5	3	8
	ND	0	2	2
		5	5	10

2/3

COY-1% (+ MJRA)		D	ND	
	D	5	4	9
	ND	0	1	1
		5	5	10

II: 3 candidates, 7 reference cultivars ----> 24 comparisons
8 characters

2 years : 85 and 86

2/2 -1%

COY-1%		D	ND	
	D	3	4	7
	ND	0	17	17
		3	21	24

2/2 -1%

COY-1% (+ MJRA)		D	ND	
	D	3	10	13
	ND	0	11	11
		3	21	24

III 7 cultivars ----> 21 comparisons
8 characters
2 years : 86 and 87

2/2 -1%

		D	ND	
	D	7	5	12
	ND	1	8	9
		8	13	21

2/2 -1%

COY-1% (+ MJRA)		D	ND	
	D	8	8	16
	ND	0	5	5
		8	13	21

End of Annex II

[Annex IV follows]

COMPARISON BETWEEN ACTUAL UNIFORMITY DECISIONS AND THOSE FOUND BY THE OVER-YEARS UNIFORMITY CRITERION

Introduction

Actual uniformity decisions in the UK are presently made on results of a uniformity assessment made in each year of testing. In each year the standard deviation of a candidate is compared with the distribution of standard deviations for the control varieties. The number of years out of 2 or 3 in which the standard deviation of a candidate is larger than a position in this distribution exceeded by only 1% of the control varieties is determined. A variety is considered to be uniform if this occurs in at most one year for the 3 year case or does not occur at all in the 2 year case.

Comparisons

The results of actual uniformity decisions made by the above criterion have been compared with those made on the over years uniformity criterion for candidate varieties considered in 1986 and 1987 for grass species in the UK. In these comparisons the over years criterion has been used at P=0.01 and P=0.001.

Results

(a) 2 year case

Better agreement between actual decisions and over year decisions is obtained at P=0.01. At P=0.001 the over years criterion passes considerable more varieties.

(b) 3 year case

In this case better agreement is obtained at P=0.001. At P=0.01 considerably fewer varieties are passed by the over years criterion.

Conclusion

A standard of P=0.001 at 2 years and P=0.01 at 3 years for the over years criterion would provide best agreement with the present individual year criterion. However it is noted that the present criterion provides a much larger number of non-uniform varieties after 2 years of testing than at 3 years. It may therefore be possible to use the over years criterion at P=0.001 at both 2 and 3 years in the UK.

S T C Weatherup
Biometrics Division
6th June 1988

TABLE 1: Comparison between actual uniformity decisions and those found by new criterion (P=0.001)

(PRG & IRG Diploids)

(a) <u>2 years</u> (86/87)

		Actual		
		U	NU	
New criterion (P=0.001)	U	11	9	20
	NU	0	3	3
		11	12	23

(b) <u>3 years</u> (85/87)

		Actual		
		U	NU	
New criterion (P=0.001)	U	15	1	16
	NU	3	0	3
		18	1	19

/

TABLE 2: Comparison between actual uniformity decisions and those found by new criterion

(PRG Diploids 1984, 85 & 86)

(a) 2 years (85/86)

		Actual U	Actual NU	
New criterion (P=0.001)	U	24	8	32
	NU	2	2	4
		26	10	36

(b) 3 years (84/86)

		Actual U	Actual NU	
New criterion (P=0.001)	U	18	0	18
	NU	0	0	0
		18	0	18

TABLE 3: Comparison between actual uniformity decisions and those found by new criterion (P=0.01)

(PRG & IRG Diploids)

(a) <u>2 years</u> (86/87)

		Actual		
		U	NU	
New criterion (P=0.01)	U	9	6	15
	NU	2	6	8
		11	12	23

(b) <u>3 years</u> (85/87)

		Actual		
		U	NU	
New criterion (P=0.01)	U	12	1	12
	NU	6	1	7
		18	1	19

TABLE 4: Comparison between actual uniformity decisions and those found by new criterion (P=0.01)

(PRG Diploids 1984, 85 & 86)

(a) 2 years (85/86)

		Actual		
		U	NU	
New criterion (P=0.01)	U	22	5	27
	NU	4	5	9
		26	10	36

(b) 3 years (84/86)

		Actual		
		U	NU	
New criterion (P=0.01)	U	15	0	15
	NU	3	0	3
		18	0	18

[Annex V follows]

BUNDESSORTENAMT
L I 1 - 173

Hannover, 06.06.1988

Pairwise comparison of varieties for testing distinctness

1. UPOV document TG/1/2 recommends in par. 23 to 25:

23. If a normally visually observed quantitative characteristic is the only distinguishing characteristic in relation to another variety, it should be measured in the case of doubt, if this is possible with reasonable effort.

24. In any case it is recommended to make a direct comparison between two similar varieties since direct pair-wise comparisons show the least bias. In each comparison it is acceptable to note a difference between two varieties as soon as this difference can be seen with the eye and could be measured though this measurement might require unreasonable effort.

25. The simplest criterion for establishing distinctness is that of consistent differences (significant differences with the same sign) in pair-wise comparison provided that they can be expected to recur in the following trials. The number of comparisons has to be sufficient to allow a comparable reliability as for measured characteristics.

2. So the approach for visually assessed characteristics is:

- put the two very similar varieties together side by side, according to the findings from the Technical Questionaire or from the first year's results

  a) in one or two replicates as the usual test layout may be, observing and judging whether the difference is clear, taking into account the fluctuation within these two varieties, or

  b) in eight to ten replicates, observing whether there is a difference in the same direction for all replicates (sign test)

Both alternatives give results for one year each and can not replace a second year in the TG/1/2 rule for distinctness "... clear difference in two consecutive or two out of three years".

Alternative a) is certainly a quite usual procedure without problems. In view to alternative b) it would be helpful to know the experience in the different countries, and possibly statistical advice could be given to make the test more efficient, as the requirement of eight to ten replicates is a rather high requirement for the test lay-out.

3. For <u>measured characteristics</u> the same situation can arise that two varieties should be compared only with each other. The basis for it can be

   a) both varieties are put together side by side in each replicate;

      in this case the question arises
      - whether the number of replicates should be the same as for the usual test lay-out, i. e. three
      - whether the simple t-test in combination with TG/1/2 rule "... two consecutive or two out of three years" is the only adequate procedure.

   b) both varieties are distributed at random in the three replicates;

      in this case the question arises
      - whether the LSD resp. the COY analysis calculated for the whole trial has to be taken, or
      - whether a specific test is possible which takes into account only these two varieties to be compared.

G. Fuchs

[Annex VI follows]

DESCRIPTION OF VARIETIES

(Based on Summary of Main Differences Prepared by the Chairman)

Notes (1 to 9) used in UPOV variety descriptions have to be calculated from characters on which continuous measurements are made. Methods and periods of testing can vary from crop to crop within countries.

The methods adopted (for grasses except for ES and IL) differ as follows:-

	D	DK	ES	FR	IL	NL	UK	IR
1. Scores calculated each year	√			√				
or based on character means over years			√		√	√	√	√
2. LSD to separate 2 consecutive notes	1%		1% or 5%	1%	-	1%		5%
3. LSD based on plot variation within years	√		√ (max)	√		√ (max)	COY	√
overyears analysis							√	
4. Method of stabilising notes over years								
Statistical regression			√			√		
'slotting in' between reference varieties		√		√			√	
5. Numbers of years to description								
Provisional			2or3	2	2 (x2tests)	2or3		2
Final	2or3	2or3	4or5	5	-	3*	5	2 or 3

NL is not permitted, by law, to alter a variety description so stabilisation over years is essential.

The variety descriptions can be identical for two varieties which are distinct. Some countries expressed concern about this and wish there to be a link between the description and the basis for distinctness.

In assigning notes to a set of varieties some, but not all countries, set note 5 equal to the mean of the UPOV collection of varieties.

A thorough study of differences of method seems to be required.

* Newly developed characteristics take 5 years to be incorporated into the variety description.

[Annex VII follows]

Data Base Management Systems in Use in UPOV Member States

Name	Hardware - OS	Min. Config	Multi-user	Type	Data used	Interactive	Query language	Security	Recovery	Net Work	Interface	Comments
ORACLE (version 5)	VAX II - VMS (NL) PRIME-PRIMOS (UK) most others IBM, PC etc	1 mByte though 2 mByte recommend	✓	Relational	Variety (NL) Seed (NL) Administrative (NL,UK)	✓	SQL	✓	✓	✓ (not yet on PRIME)	Fortran Pascal Cobol	
SESAM	Siemens - BS2000 (D)	?	✓	Relational	Technical (D) Admin (D)	✓	SQL	✓	✓	✓	Fortran Cobol RPG	Restricted interface with Fortran
dBase III+	IBM PC - MS DOS (ES) IBM AT3 - DOS 3.1 (DK) XT286 - DOS 3.3 (DK) Apricot Xen - MS DOS (UK) and Xeni " (UK) all IBM compatibles - PC DOS	256 KB		Relational	Technical (ES,UK,DK) Admin (ES,UK)	✓	dBase commands			✓	Assembly Language only	
Fox Base +	Apricot Xeni - MS DOS (UK)	256 KB	(Multi-user version available)	Relational	Variety (UK) Admin (UK)	✓	Fox Base commands			?	Assembly Language only	
INFORMATION	PRIME- PRIMOS (UK)	1 mB on PCS	✓	Relational-like	Seed - Admin (UK)	✓	INFORM	✓		?	INFO-BASIC interface to 3GLS but not easy	Lack of portability Poor recovery/ security
MIMER	CPX 8/85 - VS2/MVS (S)	?	✓	?	Technical (S) Admin (S)	✓ ✓	MIMER DB	✓	✓	✓	✓	
INFORMIX	ZILOG 130 - UNIX (S)		✓	Relational	Admin (S)	✓	SQL	✓	✓	✓	✓	
RDB	VAX 750 - VMS (F)		✓	Relational	Technical (F) Admin (F)	✓	RDO (SQL-like)	✓	✓	✓	✓	Application with forms difficult to develop
SIR	AMDAHL/100 - MVS (DK) and many others - DOS, VMS	?	✓	Heirarchical	Research data (DK)	✓	SIR-retrieval or SQL	✓			Fortran Cobol	Difficult expensive and slow

[Annex VIII follows]

Program Name	Function	Reference	Programming Language	Available from
Procedures using the statistical package SAS (can be copied by users of SAS)				
SAS-SUMMARY	Calculates summary measures			K Kristensen Denmark
SAS-ANOVA SAS-GLM	Calculates analyses of variance, variety means and LSD values			
SAS-PLOT	Residual plots and plots of standard deviations against plot number and/or means.			
SAS-SESMEAN	Creation of data sets to be input to SESTVAL, (Non-homogeneous data sets require IMSL routines which cannot be copied)			
SAS-SESTVAL	Performs pairwise comparisons between varieties (Adaptation of Weatherup's TVAL).			
SAS-IBGEN	Generates (0,1) and (0,1,2) incomplete block designs from generating arrays (Adaptation of IBGEN from AFRUS Edinburgh.			
SAS-IBAN	Analyses of incomplete block designs (Adaptation of IBAN from AFRUS Edinburgh).			

Program Name	Function	Reference	Programming Language	Available from
SES TEST	Distinctness testing for herbage & grasses, some programs tailor made for designs with 3 complete blocks of (at most) 20 plants. a) Data validation		Fortran 66	K Kristensen Dataanalyisk Laboratorium Lottenborgvej 24 DK-2800 Lyngby DENMARK
SESI TAB	b) calculates summary measures			
SES2 TAB	c) Storage of summary measures, no of plants, variety name & number			
SESSELV	d) Compares candidate with reference varieties. Differences are calcu lated printed & compared with LSD value.			
General	a) general programs; file handling; database checking variety denominations.		Fortran	A Van der Burgt & H Schuitemaker Nieuwe Wageningseweg Bennekom RIVRO PB 32 6700AA Wageningen Holland
DUS trials	b) programs for processing data from DUS trials (summary measures, analyses of variance)			
Hand held terminals	c) programs to handle designs and data from hand held terminals. (transfer of data, testing for outliers data file handling).			
VCU trials	d) programs for processing data from performance trials (one-way ANOVA and two-way non orthogonal ANOVA. Weights, over trials analyses. Adaptions for Specific crops).			

Program Name	Function	Reference	Programming Language	Available from
COMPAR AISON	The score of the candidate variety for each characteristic in turn is tested against the reference variety. Program stops when one difference is found.	?	Fortran 77	INRA - GEVES 78280 Guyancomt FRANCE
COMPAR TOUT	As above except that all differences between candidate and reference variety are noted.			
CARAMES	For characteristics which used actual measurements comparison is made with a theoretical standard.			
CLASMOYENNE	As above but measurement is converted to a score.			
VCAN JOANA	Used for DUS Forage Crops for quantitative characters. Gives number of plants, means, variances by rep and by sample - carries out ANOVA, sorts, DUNCAN and NEUMAN - KEULS test for qualitative characters.			
VCAL	Gives number of plants by score, by rep and by sample. Comparisons between each pair.			
MIMOSA	Summarises the results obtained by VCAN and VCAL.			

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Program Name	Function	Ref	Language + OS	Available from
SAS-ENSART	A macro for uniformity testing - 'the Danish way.'			

III Programs written for Microcomputers - can be purchased.

Program Name	Function	Ref	Language + OS	Available from
VAERDI	Tabulations of data from performance testing of grasses and herbage crops. Handles data from different cuttings and localities.	-	Pascal (turbo-pascal) for CP/M	K Kristensen Denmark
DATASTAR	Data entry and simple conversions.	-		
MICROSTAT	ECOSOFT.INC program. Used for statistical analysis (ANOVA) on data from performance testing of cereals grasses and herbage crops.	-		
AGRITRIALS (needs dBase II software for complete package	For recording and processing data from crop variety trials. a) maintains variety descriptions and other indices. b) generates and stores trial layouts. c) inputs data from a variety of sources (including data loggers). d) assembles data from one or more such sources into datafiles. e) analyses trials data (ANOVA etc) with estimation of missing values. f) transfers data files to other computers g) amends and/or transforms data files h) storage of summarised results for future investigations. i) retrieval of results for over-trial analyses.	-	Micro-soft BASIC and PASCAL for MS.DOS micros	F G Pullen NIAB Huntingdon Road Cambridge England.

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	j) maintains environmental data associated with trials.		
DUS ornamentals (uses dBase II Wordstar software	Maintains records representing DUS assessments of chrysanthemum varieties. Records from successive years compared and differences highlighted. Summary reports compiled and printed in statutory format using Wordstar word processing package.	PASCAL + MSDOS	F G Pullen NIAB Cambridge England
DUS Vegetables Reference Collection (Uses dBASE II software)	Similar to above. Summary records constitute a reference collection of established varieties. For each candidate variety, data base is scanned to provide a short list of control varieties which resemble the candidate.		"

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[Annex IX follows]

EAST CRAIGS PISUM DATABASE - DESCRIPTION

LEGEND

GENETIC INFORMATION for characters with gene symbols(* 1)

0 Dominant expression
1 Recessive expression
h Expression hidden by the effect of other gene(s)
s Segregation

(Gene symbols in quotes are of uncertain status)

ALLELIC SERIES for genes with more than two alleles

0 - 4 Allelic expression in order of dominance

DISEASE REACTION for characters without gene symbols

R Resistant
S Susceptible

DISEASE REACTION for all disease characters

5 Susceptibility claimed, but not verified
6 Resistance claimed, but not verified
7 Susceptibility claimed, but test resistant or other conflicting claim(s)
8 Resistance claimed, but test susceptible or other conflicting claim(s)
9 Field tolerance or field resistance claimed

OTHER INFORMATION

1 -9 Characters for which there are no gene symbols follow the UPOV notation (* 2)

c Data to be checked

'-' Character not recorded

* 1 Blixt,S.(1977).'The gene symbols of Pisum".Pisum Newsl.9 (Supplement) 1 - 59. Available from The Pisum Genetics Association,G.A.Marx,Department of Seed and Vegetable Sciences, New York State Agricultural Experiment Station, Geneva NY 14456, U.S.A.

* 2 UPOV (1981)."Guidelines for Distinctness,Homogeneity and Stability : TG/7/4 Peas". International Union for the Protection of New Varieties of Plants, Geneva, Switzerland.

UK PISUM CULTIVAR DATABASE - CULTIVAR DESCRIPTION Page 1

CULTIVAR: Maro SYNONYM:
AFP:84/ 22 YEAR COMMERCIALISED: 1964 DATE: 23 Mar 88

GENE	CHARACTER	STATES	DATA
	FOLIAGE CHARACTERS		
le	Habit	0 tall 1 dwarf	1
	Stem length at H3	cm	49
bif	Stem bifurcate	0 absent 1 present	0
af	Leaflets	0 present 1 absent	0
'x'	Tare leaved	0 absent 1 present	0
ins	Leaflet tip inc.	0 absent 1 present	0
Ser	Leaflet serate	0 present 1 absent	1
Inci	Leaflet incised	0 present 1 absent	1
st	Stipules	0 normal 1 reduced	0
	Stipule length	3 short 5 medium 7 long	3
	Stipule breadth	3 narrow 5 medium 7 broad	3
fl	Flecking	0 strong 1 med.2 sparse 3 abs.	1
	Flecking intensity	3 slight 5 medium 7 much	4
	Leaflet pairs (max)	1 one 3 two 5 three	5
	Leaflet length	3 short 5 medium 7 long	3
	Leaflet breadth	3 narrow 5 medium 7 broad	2
td	Dentation	0 present 1 absent	0
	Leaf dentation	3 slight 5 medium 7 much	2
fas	Fasciation	0 absent 1 present	0
d	Axil pigment	0 double ring 1 single ring 2 two spot 3 four spot 4 abs.	h
un	Leaflet margin	0 not-undulate 1 undulate	0
cov	Foliage blue	0 absent 1 present	0
o	Foliage yellow	0 absent 1 present	0
	Foliage colour	3 pale 5 medium 7 dark	5
wlo	Upper lflts waxless	0 absent 1 present	0
wel	Plants waxless	0 absent 1 present	0
	FLOWER CHARACTERS		
	Days to flowering	(after Orfac)	13
	First fertile node		14
fn:fna	Flowers	0 0 one 1 0 two 1 1 three or more	1 0
	Flowers	at 2FN	2.0
	Fertile nodes		4.0
dt	Peduncle	0 long 1 short	0
	Peduncle length	1 sess.3 short 5 med.7 long	4
a	Anthocyanin	0 present 1 absent	1
am	Flower pink blush	0 absent 1 present	0
b	Flower pink	0 absent 1 present	0
Cit	Flower lemon yellow	0 present 1 absent	1
Cm	Flower coral-rose	0 present 1 absent	1
	Standard Anth. int.	3 slight 5 medium 7 much	h
Kp	Keel spot	0 present 1 absent	h
	Wing anth. int.	3 slight 5 medium 7 much	h
	Standard	3 white 5 int 7 cream	5
	Standard vein col.	3 slight 5 medium 7 much	4
	Standard width	3 narrow 5 medium 7 broad	6
	Standard base shape	3 raised 5 level 7 arched	7

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UK PISUM CULTIVAR DATABASE - CULTIVAR DESCRIPTION Page 2

CULTIVAR: Maro SYNONYM:
AFP:84/ 22 YEAR COMMERCIALISED: 1964 DATE: 23 Mar 88

GENE	CHARACTER	STATES	DATA
POD CHARACTERS			
bt	Pod tip shape	0 blunt 1 pointed	0
	Pod attitude	1 vert. 2 int. 3 horiz.	1
twp	Pod twisted	0 absent 1 present	-
Dpo	Pod dehiscent	0 present 1 absent	1
def	Funiculus thickened	0 absent 1 present	0
	Pod wall colour	3 pale 7 dark	3
dp	Pod wall blue-green	0 absent 1 present	0
	Fresh seed colour	3 pale 7 dark	3
	Pod con. curvature	3 slight 5 med. 7 intense	2
	Pod length	mm	74
	Pod breadth	mm	12
	Ovules per pod		8.3
Pu	Pod pigment	0 purple 1 partial 2 slight 3 green	h
sru	Suture	0 green 1 purple	h
rup	Anthocyanin spots	0 absent 1 present	h
Astr	Pur./violet stripes	0 present 1 absent	1
n	Pod wall	0 normal 1 thickened	0
Np	Neoplasms	0 present 1 absent	-
sin	Suture strings	0 present 1 absent	0
gp	Yellowish pods	0 absent 1 present	0
p,v	Parchment	0 0 present 0 1 patches 1 0 stripe 1 1 absent	0 0
SEED CHARACTERS			
a	Anthocyanin	0 present 1 absent	1
z	Furca	0 absent 1 present	-
mp	Enlarged furca	0 absent 1 present	-
rag	Grey radicle patch	0 absent 1 present	-
gri	Grey median stripe	0 absent 1 present	0
M	Testa marbling	0 present 1 absent	1
F	Seed spotting	0 strong 1 present 2 absent	h
u	Violet testa	1 uniform 2 stripes 3 absent	h
Obs	Obscuratum	0 present 1 absent	h
l	Round	0 absent 1 present	h
di	Dimpled seed	0 absent 1 present	1
i	Cotyledon colour	0 yellow 1 green	1
r	Starch grains	0 simple 1 compound	0
rb	Simple starch grn.	0 smooth seed 1 wrinkled seed	h
Pl	Hilum	0 black 1 not black	1
mifo	Golf ball dimpling	0 absent 1 present	1
Tra	Tragacanth	0 present 1 absent	0
fov	Radicle Slit	0 absent 1 present	0
Ep	Testa thickness	1 v.thick 2 thick 3 thin	3
Gty	Testa surf. gritty	0 present 1 absent	1
	'Gritty' testa	1 coarse 2 fine	h
s	Chenille	0 absent 1 present	0
	Surface wrinkling	0 absent - 9 intense	0
	Shape	1 spherical 2 aspherical 3 drum 4 disc 5 wedge 6 irregular 7 rhomboid	7 to 5
	100 seed weight	gm	37

UK PISUM CULTIVAR DATABASE - CULTIVAR DESCRIPTION Page 3

CULTIVAR: Maro SYNONYM:
AFP:84/ 22 YEAR COMMERCIALISED: 1964 DATE: 23 Mar 88

GENE	CHARACTER	STATES		DATA
	REACTION TO DISEASE CHARACTERS			
	Bacterial:			
	Pseudomonas syringae pv pisi race 1	R res.	S sus.	
	Pseudomonas syringae pv pisi race 2	R res.	S sus.	
	Pseudomonas syringae pv pisi race 3	R res.	S sus.	
	Pseudomonas syringae pv pisi race 4	R res.	S sus.	
	Pseudomonas syringae pv pisi race 5	R res.	S sus.	
	Pseudomonas syringae pv pisi race 6	R res.	S sus.	
	Viral:			
En	Pea Enation Mosaic Virus	0 res.	1 sus.	
lr	Pea Leaf Roll Virus (Tops Yellow)	0 sus.	1 res.	
mo	Pea/Bean Mosaic Virus	0 sus.	1 res.	
sbm	Seed Borne Mosaic Virus	0 sus.	1 res.	
	Fungal:			
er	Erysiphe polygoni Syd.(powdery mildew)	0 sus.	1 res.	
er1	Erysiphe polygoni Syd.(powdery mildew)	0 sus.	1 res.	
er2	Erysiphe polygoni Syd.(powdery mildew)	0 sus.	1 res.	
Fw	Fusarium oxysporum f. sp. pisi race 1	0 res.	1 sus.	0
Fnw	Fusarium oxysporum f. sp. pisi race 2	R res.	S sus.	
	Fusarium oxysporum f. sp. pisi race 4	R res.	S sus.	
	Fusarium oxysporum f. sp. pisi race 5	R res.	S sus.	
	Fusarium oxysporum f. sp. pisi race 6	R res.	S sus.	
	Ascochyta pisi (leaf and pod spot)	0 res.	1 sus.	
	Mycosphaerella pinodes (blight)	R res.	S sus.	
rpv	Peronospora viciae	0 sus.	1 res.	
	(Foot rot complex)			
	Aphanomyces enteiches f. sp. pisi	R res.	S sus.	
	Fusarium solani f.sp. pisi	R res.	S sus.	
	Phoma medicaginis var pinodella	R res.	S sus.	

PEDIGREE:

Big Ben x (Noordhollandse Rozijn x Zelka)

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SLIDE 1

EAST CRAIGS SEED COLLECTIONS

There are six sets of seed collections:

i) Cereals Collections
ii) Potato Collections
iii) Pisum Collections
iv) Brassica Collections
v) Carrot Collections
vi) Leek Collections

(These include the UK Cultivar Registration Collections)

SLIDE 2

EAST CRAIGS PISUM COLLECTIONS

There are five seed collections of Pisum:

i) UK Pea Cultivar Registration Collection
ii) Pisum Cultivar Collection
iii) Pisum Line Collection
iv) Pisum Wild Type Collection
v) Pisum Variant Collection

SLIDE 3

EAST CRAIGS PISUM DATABASE

This database was primarily designed to meet the needs of of Technical staff carrying out registration work on Peas.

It holds data on all Peas contained in the five Pisum Collections. This includes all commercial cultivars listed on both the EEC Common Catalogue and the UK National List.

EAST CRAIGS PISUM DATABASE

ORGANISATION OF DATA

1. ADMINISTRATIVE/PASSPORT

a) Data at the cultivar level
b) Data at the accession level

2. DESCRIPTIVE

a) Morphological
b) Pathological
c) Pedigree
d) Text

3. OTHER

a) Photographic
b) Name and address
c) Experimental

SLIDE 5

EAST CRAIGS PISUM DATABASE

TYPES OF MORPHOLOGICAL DATA

1. QUALITATIVE

a) Score data for discontinuously expressed characters

i) phenotype of known genotype
ii) phenotype of unknown genotype

2. QUANTITATIVE

a) Score data for continuously expressed characters
b) Measured data for continuously expressed characters

SLIDE 6

EAST CRAIGS PISUM DATABASE

CHARACTER TYPES USED

CHARACTER TYPE	NUMBER
Qualitative data :	
- score for phenotype of known genotype	75
- score for phenotype of unknown genotype	10
Quantitative data :	
- score for continuous characters	20
- measurements for continuous characters	50

[Not all characters are recorded for all material]

Slide 7

EAST CRAIGS PISUM DATABASE

STORAGE OF QUANTITATIVE DATA

Data is stored in two forms:

1. **Within year means**
2. **Over year means**

Both forms of data may be displayed by using the 'Collation' facility. As new data is added Over year means are recalculated.

Slide 8

EAST CRAIGS PISUM DATABASE

PATHOLOGICAL DATA

Source of data

1. Results of tests
2. Published information
3. Claim made by breeder

Conflicting data is uniquely coded with appropriate comments in text

Slide 9

EAST CRAIGS PISUM DATABASE

STEPS FOR THE ADDITION OF DATA

1. **Individual plant measurements collected on Datamyte or Husky Hunter capture machines**

2. **Data emptied into Microcomputer and validated**

3. **Raw data processed to produce :**

   - plot means for each character
   - standard deviation
   - sample number
   - ANOVA
   - LSD's and within year cultivar means for each character

4. Within year means added to 'Collation'

5. Recalculation of over year means and replacement of values on Pisum Database

EAST CRAIGS PISUM DATABASE

OUTPUT

1. **Descriptions**

   a) **UPOV Cultivar description**
   b) **East Craigs Pisum Database description**

2. **lists of cultivars with specific combinations of attributes on interrogation**

3. Seed orders

SLIDE 11

EAST CRAIGS PISUM DATABASE

ADVANTAGES

1. Classification can be iterative, and can be performed with incomplete data

2. Copes with uncertain data

3. Copes with variable character type and notation

4. Character dependence is accommodated

5. Quality of information is high

6. Designed to service technical experts

[Annex X follows]

VCU CROP	Country	Nos. of trials Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	No. of reps	Plot length (m)	Plot width (m)	Treatments	Groupings	Experimental Design†	Notes
Cereals	DK							3			2 nitrogen 2 fungicide	-	SP	
	F	15	15					3	5/10	1.2	2 fungicide	groups for maturity treatment & sowing date	RB	1 trial with fungicide, 1 without
	NL	17	17	17	17			3	10	3	2 fungicide	None	IB	
	S	19	19	21	21			3/4	12.5	2	fungicide yrs 3 & 4	2 mat groups*	IB (yrs 1 & 2) SP (yrs 3 & 4)	*Spring and winter cereals classified as different groups
	SP Major crops Minor crops	18 5	18 5					3/4	12/15	1.2/1.5	-	-	RB - ** or IB	**Design chosen depends on numbers of varieties in trial
	UK Major crops Minor crops	8/10 5/7	8/10 5/7					2	16/18	2	2 fungicide (yr 2) None	None None	IB (Yr 1) SP)(Yr 2) or SL) IB (yrs 1 & 2)	Yr 1 & 2 varieties grown in same trial
Perennial Ryegrass PRG	D	5/12	10/13	10/20				3/4	4/6	1.0/1.2	2 nitrogen	3 maturity groups	RB	
	F	7/8	7/8	7/8				5	5	1.2	None	2/3 maturity groups	RB	
	IR	5	10	5				4	5	1.2	5 nitrogen pa	3 maturity groups	RB	
	S	4	4	4				4	10/15	1.5/2.0	-	Yes	RB	
	UK	4/7	4/7					2	5	1.2	-	3 maturity groups	IB or RB	4 trials for simulated grazing management 7 trials for conservation management
Grain Peas, Winter & Spring Beans	UK	5/6	5/6					3/4	16/18	2	-	None	RB	Yr 1 & 2 varieties grown together
Forage Maize	F	13	13					3/4	5	1.6	-	9 maturity groups 7 for corn 2 for silage	RB	
	S	7	7	7	7			4	12	3	-	None	IB	
	UK	6	6	6				3/4	15	1.5	None	None	IB	
Sugar Beet	Sp	5/18	5/18					6	12/15	1.2/1.5	-	-	RB or IB	
	UK	6	16	16				4	10	2	None	None	IB	
Fodder rape, kale, swede	S	8	8	8	8			4	12	2	-	None	RB	
	UK	3/9	3/9	5/9†				4	5/18	1.25/2	None	None	IB	†3 trials for Fodder Beet (2 yrs only) 9 trials for swede, 5 for kale
Oil seed rape Winter	UK	6/8	8/12					3/4	20	2.5	None	None	IB	
Spring		3	3					4	17	2.0	None	None	IB	
Potatoes 1st early	UK	3	3					2	6.08	0.61	3 lifting dates	***	SP	*** Separate trials for each maturity group
2nd early		3	3						6.08	0.915	2 lifting dates		SP	
main crop		3	3						6.08	3.04	-		RB	
Turf plants	S	6	6	6	6			4	2	2	4 nitrogen	None	RB	
White clover	UK	7	7					2	5	1.2	-	-	RB	
Timothy		4	4					2	5	1.2	-	-	RB	
Italian Ryegrass		7	7					2	5	1.2	-	-	IB	

† key to experimental design
RB randomised block
IB incomplete block
SP split plot
SL split lattice (i.e. split plot in incomplete blocks)

Crop	Country	Trial Details	No. of reps	Maturity Groups	Experimental Design
Cereal	DK	1 plot 5m x 1.5	1	-	Systematic (barley)
	F	3 years 2 sites ear rows 1.5 x 0.25m (uniformity) plots 1.5 x 1.5m (distinctiness)	2	Grouped in Year 2 according to Year 1 results	No statistical layout
	S	Max. 3 years - usually 2 ear rows 120 plots 8 x 1.2m	2	Varieties sorted according to breeders description and experience	Systematic
Field peas	DK	2 or 3 years 1 trial 7.5m x 1.5m	2	2 groups for maturity	Systematic
Grasses	F	Max. 4 years - usually 3 1 or 2 trials 7 x 0.62m (spaced plants) 4 x 0.5 (row plots)	3	Grouped for ploidy and maturity	RB
	NL	3 years single plants 2 rows 1 plot 2 x 10 plants	3	Group for maturity (PRG)	RB (not completely)
	IR	2 years 1 trial 60 single plants (6 x 10)	6	3 Groupings for maturity	RB
	D	3 years 1 trial 4 x 0.12m	3/4	3 Groupings for maturity (PRG, red fescue)	RB Systematic
	S	Max. 3 years - usually 2 years 60 spaced plants - 3 reps of 20 + 5m x 1.2m plot	3	Varieties sorted according to breeders description and experience	Systematic
Fodder Maize	F	Max. 3 years - usually 2 2 trials, 2 rows of 5m For hybrids 2 reps of 4 rows	2	Grouped according to 5 characteristics maturity, grain type, light colour of silk, colour of cob	2 reps in the same order
	S	Usually 2 years 1 trial, 6 x 1.5m	3	Sorted according to breeders description and experience	Systematic
Fodder rape, rape, turnip rape, kale	S	Usually 2 years 1 trial, 5 x 1.2m	3	Sorted according to breeders description and experience	
Fodder beet	DK	2 or 3 years, 7 trials, 7.5 x 2.2m	2	4 groups	Systematic
Sugar beet	UK	3 years, 1 trial, 10 x 2m	4	No groupings	IB - VCU trial used
	DK	2 or 3 years, 1 trial, 7.5 x 2.2m	2	4 groups	Systematic
Oilseed Rape	DK	2 or 3 years, 1 trial, 7.5 x 1.5m	2	2 groups	Systematic
	UK	2 years, 1 trial, 10m x 2	4	3 groups	RB
White mustard	DK	2 or 3 years, 1 trial, 7.5 x 1.5m	2	None	Systematic
Onions	UK	3 years, 1 trial, 9 x 0.75m (single row)	4	1 or 2 major groups 5 altogether	RB
Faba beans	UK	3 years, 1 trial, 9 x 0.75m (single row)	4	Grown as 1 large trial but subdivided for comparisons at analysis stage	RB

Key to experimental design

RB - randomised block
IB - incomplete block

[End of Annex X and of document]