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INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS

GENEVA

TECHNICAL WORKING PARTY FOR ORNAMENTAL PLANTS AND FOREST TREES

Twenty-eighth Session
Wageningen, Netherlands, September 4 to 9, 1995

REPORT

adopted by the Working Party

Opening of the Session

1. The twenty-eighth session of the Technical Working Party for Ornamental Plants and Forest Trees (hereinafter referred to as "the Working Party") was held at Wageningen, Netherlands, from September 4 to 9, 1995. The list of participants is presented in Annex I to this report.

2. Mr. A. Franken, Deputy Director of the CPRO-DLO, Department of DUS-Testing, welcomed the participants to Wageningen and gave a short overview on the structure of the CPRO-DLO, the different departments, working themes, groups of crops, products and its statutory tasks. The session was opened by Mrs. U. Löscher (Germany), Chairman of the Working Party.

Adoption of the Agenda

3. The Working Party unanimously adopted the agenda of its twenty-eighth session which is reproduced in document TWO/28/1 after having agreed to delete items 13(g) (Geralton Wax Flower), (i) (Thymus) and (m) (Ornamental Apple), to include "Hevea" under item 13 and to devote the first day of the session exclusively to image analysis. It furthermore agreed to discuss items 13(c), 13(d), 13(e) and 13(k), 13(l) and Hevea first in two parallel subgroup meetings.

The Use of Image Analysis in the DUS Testing of Ornamental Plants

4. The Working Party noted that the Technical Committee had requested that a survey should be made of what had already been done in the field of image analysis and what problems had been encountered with that tool in variety testing. The Working Party recalled that the expert from the Netherlands had been asked to prepare a questionnaire (Circular U2218) for distribution to the experts and for answers to be returned before January 31, 1995. The following items had already been identified as aims of the study of image analysis:

(a) Faster measuring of characteristics;

(b) Storage of data collected with image analysis;

(c) Finding of similar varieties through checking of stored data on image analysis;

(d) Digitalized storage of photos.

5. The Working Party also noted information on a research proposal for the European Communities written as a result of a Questionnaire on Image Analysis in Variety Testing (Circular U 2220). The project was submitted to the FAIR-program of the European Communities in March 1995 under the acronym VISOR. The objectives of the project were to:

(a) establish best practice guidelines in applying image analysis to testing for distinctness, uniformity and stability;

(b) develop computer systems which automate the production of scores for characteristics that are currently visually-assessed;

(c) develop an image database system for plant varieties which can take an image of one variety and compare it with other images of varieties of the same species in order to identify the closest visual match.

6. The Working Party noted that although the VISOR project was restricted to European Union member States, its approaches could be beneficial to all UPOV member States.

7. The Chairman stressed that it was necessary to avoid that the methods under study in the different member States deviated too much, that aims should be collated and that it should be discussed how closer cooperation and harmonization could be achieved.

8. The Working Party noted different reports on the stage of study of image analysis in the different member States.

9. Mr. David Warren (United Kingdom) reported on the research done at the NIAB at Cambridge where over the past few years image analysis techniques had been successfully applied to DUS related work in several crops. There were now PC-based systems in routine use that measured the length and breadth of oil seed rape cotyledons, *Faba* bean leaves and *Faba* bean pods. The Image Analysis Section was currently working to build a more ambitious system which would automate the DUS assessment of chrysanthemum leaves. The system would generate leaf descriptions in terms of the characters defined in the current UPOV

Guidelines. It would assess all but four of the leaf characteristics, print a report sheet and a sheet of leaf silhouettes for each variety and transfer the data directly into the chrysanthemum DUS database. The office was also experimenting with more objective, more accurate descriptions of the leaf shapes which would be extremely tedious to generate by hand. The system would generate leaf shape descriptions of this kind in addition to the standard assessments. They would be used to search the database for known varieties whose leaves were similar to a given candidate and may prove useful in identifying new characteristics which could be measured accurately by machine but still be assessed easily by eye. Mr. Warren explained in detail the different steps, image acquisition, measurement of each of 10 leaves of a variety, generation of the report, transfer of data and archiving of the image. He pointed to problems, e.g. the overlapping of the sinus of the lobed leaf, the measuring of the apex and the base with the difficulty to define how far the apex or base reached and the difficulty in interpretation in case of differences observed inside the 10 leaves (e.g. what to do if five leaves were acute and five rounded).

10. Mrs. Marie Hélène Gandelin (France) reported on the examination of flowers and petals of roses through scanner images, measuring global parameters as area and color images. She also pointed out the difficulties caused by the variation of shape and color distribution. One single method was therefore considered insufficient. Several methods as human measurement, image analysis and spectrocolorimetric observations had to be used together. Annex II to this report reproduces a more detailed summary of her report.

11. Mrs. Kathrin Siebert (Germany) reported on the plans of the Federal Plant Variety Office on the research of image analysis. Work had started rather late and most research was just at the beginning stage. She gave an overview on the differences between image recording and image analysis, referred to the main characteristics that could be recorded via image (length, width, area, perimeter, shape, color) and explained the set-up of hardware used in Germany. The storage of images was, different to the other reporting States, not done in digital but analogue form on a WORM (Write Once Read Many) disk and would be converted by a Frame Grabber into digital form when needed. Research would be done on pelargonium (leaf, flower, petals) and on rye (number of grains). A more detailed summary of Mrs. Siebert's report is reproduced in Annex III to this report.

12. Mr. Gerie van der Heijden (Netherlands) reported on the study of image analysis in the Netherlands with the view of its possible use in DUS testing. He started his report with the observation of mushrooms, continuing with flax seed (length and width), French bean (pod, beak), cucumber (size of neck, presence of bud), carrots (EU trials), onions (bulb) and the separation of *Solanum* species with the help of the cross-section of the corolla. He concluded that image analysis was a useful tool for simple measurements, and that it was not expensive. Attention had to be paid to avoid errors in recording and analysis (e.g. broken seed). He further remarked that the measurements were accurate and needed no improvements; it was possible to form classes of shapes to link or combine characteristics on texture, color, etc. Data could easily be stored in a database and be used as a reference collection.

13. Mr. Jan Wouter Van Eck (Netherlands) reported on the observation of width, length, shape, texture and color of vegetables and gave demonstrations on observations on shapes of differently colored parts of leaves of *Ficus* (white, light green, dark green) and the calculation of the histogram of each of the three different parts, the calculation of the relative distance of the first occurrence of each of the different colors and the outside. It was stressed again that the

correct sampling was the most important part of the observation (Annex IV to this report gives more details on the above measuring).

14. Mr. Ton Kwakkenbos (Netherlands) gave a demonstration of the photo database set up by the Dutch authorities. He reported on the search for a database easy to handle, with large storage capacity (e.g. 1000 pictures per year), easy to search for pictures with possibilities of also scanning pictures from publications . He explained the hardware and software and some of the difficulties encountered in certain colors (e.g. dark red or dark green). The aim was to obtain pictures which match as well as possible the impression of the human eye.

15. Having noted all the reports, the Working Party discussed the need for more harmonization and cooperation. While some experts felt little need for harmonization, others considered it as important to reach some kind of harmonization, maybe less in the hardware, but more in the software, at least at a certain level to avoid that any progress in a country would have to be redone by another country as it could not be taken over directly. It was not necessary to have exactly the same package of hardware and software, but at least some common ground and aim.

16. Having discussed at length how to reach that harmonization and whether to set up a subgroup on image analysis on its own or together with other Technical Working Parties, the Working Party finally concluded that it was more appropriate to continue discussing the subject in the whole Working Party, thus giving all member States the chance of participation and not only those four States which at present did research on that method. Similar to what had been done during the present session, half a day should be reserved for discussions on image analysis during the next session. The Working Party agreed that it was important that also breeders participated in the discussions on image analysis, especially breeders from countries with a breeders' testing system, as they would need to be able to follow in case new characteristics were included in the Test Guidelines. It was important to get their views on these methods. The Working Party finally stressed that in preparation of the discussions during the next session emphasis should be laid on the observation of shape, size and color distribution of leaves and flowers. All countries doing research on image analysis were invited to report on their experience gained and on the problems encountered.

Short Reports on Special Developments in Plant Variety Protection in Ornamental Plants and Forest Trees

17. The Working Party received short reports from some of the experts on recent developments in their countries. The experts reported in general on an increase of applications in several countries of about 10 percent. In addition, applications were made for varieties of many new species. In general, applications for ornamental varieties covered more than half of the total applications, in some countries, as Japan, even 80 percent of all applications. The countries were working on the amendments of their laws to bring them in agreement with the 1991 text of the UPOV Convention and, as to the States also members of the European Union (EU), also in concordance with the EU plant variety protection regulations. In several countries, new texts had already been submitted to the Parliament. The expert from Israel also reported on several court cases of infringement in tomato, strawberry and ornamental varieties. The expert from Italy reported that the restructuration of the system in Italy with its

regionalization had provisionally led to the fact that applications had not reached his institute but had been kept pending in the central office in the Capital.

18. Several EU member States referred to the starting of the EU Plant Variety Protection System in April 1995. The effect of this start on the individual offices of the member State was, however, not yet foreseeable. It might lead to a reduction in the number of applications. The practical testing of the varieties was expected to continue to be made in the national offices. The Community Plant Variety Office had agreed that the UPOV Test Guidelines should be the basis for developing guidelines for the EU Office.

19. The expert from the United Kingdom informed the session of the reprint of the RHS Colour Chart which would be available from the Royal Horticultural Society in the United Kingdom.

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

20. Mr. Thiele-Wittig gave a brief report on the main items discussed during the previous session of the Technical Committee and referred participants who needed further details to the full report reproduced in document TC/31/6.

21. Definition of Off-Type: The Working Party noted that the Technical Committee had agreed to the conclusion of the TWO that each plant which showed a mutation in parts of its organs was considered to be an off-type.

22. Cooperation with Breeders in the Testing of Varieties: The Working Party noted that the Technical Committee had asked that the survey on the involvement of breeders or applicants in the testing of varieties be repeated so as to cover also non-agricultural species in order to have full details of the testing systems of the individual member States and that a new questionnaire (U2268) had been circulated for completion leading to the updated document TC/32/4. The experts from Canada and Japan explained in further detail the involvement of the applicant in their testing. In both countries, the applicant would grow the plants and the examiner from the office would visit the trials at a time when most of the characteristics could be observed. In both cases, the examiner would observe all characteristics possible at the given time. In Canada, the applicant would also have to make the same observations and the remaining ones which then would be compared by the office with its own observations. If both agreed, a decision would be taken and published giving a period of 6 months for objections. The office would also check whether the comparable varieties were correct, and if not, ask for further testing. The testing of uniformity would be left to the applicant. In Japan, in addition to the observations of the examiner, the applicant would have only to test the characteristics that had not been possible to be observed during the visit. The Japanese Office would have already at the start given the applicant detailed descriptions of the layout and on similar varieties. In case of doubts or when a candidate variety was too close to a candidate of another applicant, the office would do own tests in one of the 11 stations or in an institute or a regional authority (especially for rice). In addition to these growing tests performed by the office itself, a third possibility existed for varieties bred by public institutes where sufficient data would be available in order to rely on a written report.

23. Electrophoretic Characteristics: The Working Party noted that the majority of the Technical Committee had been of the view that it was not possible to establish distinctness solely on the basis of a difference found in a characteristic derived by using electrophoresis and that such characteristics should therefore only be used as a complement to other differences in morphological or physiological characteristics. It noted that the Technical Committee had decided to take these characteristics out of the main text of the Test Guidelines and to place them in an Annex, thereby creating a special category of characteristic and that the Test Guidelines should state that these characteristics were considered useful but that they might not be sufficient on their own to establish distinctness and thus should not be used as a routine characteristic, but only at the request, or with the agreement, of the applicant of the candidate variety.

24. UPOV Documents in Electronic Form: The Working Party noted that the Technical Committee had requested that a survey should be made in order to inquire who would be interested in documents in electronic form and for which purpose they would be needed, before asking the Office of UPOV to keep the electronic version of documents in full agreement with the printed versions. The Working Party strongly supported making available the UPOV documents in electronic form. This should not be restricted to Test Guidelines but should cover several other documents, especially reports of meetings and other more important documents. Several experts considered availability via e-mail or on-line to be the best possibility. Availability in electronic form would especially facilitate searches for certain subjects in existing documents or taking over parts for new documents.

Working Procedure for Establishing Test Guidelines

25. The Working Party noted that the Technical Committee had recommended that in the preparation of new or revised Test Guidelines there should be at least two responsible experts/countries and not just one as at present, especially in small crops where large subgroups were not justified, so as to ensure that work would continue even if a responsible expert was prevented from attending a given session of a Working Party. It had also agreed that in future new drafts would be presented to the Editorial Committee at the same time as they were sent to the professional organizations for comments and that the Editorial Committee would not limit itself to highlighting linguistic discrepancies but would also ensure that UPOV concepts were maintained in the documents, would highlight where this was not the case, and would propose, as far as possible, solutions for any such shortcomings before the next meeting of the Technical Working Party concerned.

26. Use of Disease Resistance Characteristics in Distinctness Testing: The Working Party noted that the Technical Committee had agreed that disease resistance and tolerance characteristics were acceptable for the establishing of distinctness if they fulfilled the same requirements for acceptance as any other characteristic. It noted the following definition:

Resistance: The ability of a variety or of a mono-specific population to limit the activities of a given pest or pathogen throughout the whole or a part of a growing cycle. Several resistance levels may generally be defined.

Susceptibility: Susceptibility corresponds to a zero-resistance level of a variety or population with respect to a given pest or pathogen.

Tolerance: Ability of a variety or population to tolerate the development of a pest or pathogen whilst displaying disorders that are without serious consequences for their growth, appearance or yield.

As in ornamental plants resistance characteristics were not yet used, it was, however, too early to take a general decision on their use.

27. Request for Photos in the Technical Questionnaire: The Working Party noted that the Technical Committee had supported the request for photos in the Technical Questionnaires, however, limiting the obligation to ornamental species only. It decided to include in all future Technical Questionnaires under paragraph 12(a) a sentence reading: "A representative color photo of the candidate variety should be included with the Technical Questionnaire."

28. Example Varieties: The Working Party noted that the Technical Committee had asked all Technical Working Parties to rediscuss the handling of example varieties and report to it during its next session. The Working Party agreed that under special circumstances it was more important to complete a given Test Guidelines document even without or only with few example varieties than to delay it for several years just to await the search for those example varieties. The completion of the Test Guidelines for Norway Spruce with few example varieties followed that position. The use of species to indicate expressions of characteristics would, however, remain an exception. They would be replaced by example varieties as and when they became available.

29. Genetically Modified Organism (GMO) Varieties: The Working Party noted the position of the Technical Committee vis-à-vis the handling of GMO varieties. It considered it, however, important to know when a candidate variety was a GMO. It therefore proposed to include in the Technical Questionnaire under paragraph 4 or paragraph 7 a sentence which could read: "The candidate variety represents a Genetically Modified Organism [ ] Yes, [ ] No." It asked the Technical Committee to find the final wording and to discuss whether a definition on what was considered a GMO needed to be also included as had been done in the Technical Questionnaire of the EU PBR Office.

Final discussions on Draft Test Guidelines

Draft Test Guidelines for Rhododendron (Revision)

30. The Working Party noted the draft Test Guidelines for Rhododendron (Revision) as reproduced in document TG/42/4(proj.) and comments made by the Editorial Committee. It finally made the following main changes to document TG/42/4(proj):

(i) Material Required: To have in paragraph 2 and in the Technical Questionnaire the words "meristem culture" replaced by "*in vitro* propagation." Comparable changes should also be made in all other Test Guidelines unless otherwise specifically decided.

(ii) Methods and Observations: To have in the last line of paragraph 1 the word "that" replaced by "if" not only in these Test Guidelines but also in all others where a similar paragraph was included. To have in paragraph 3 the words "after full development" deleted and the words "fully developed" replaced by "as soon as they have reached full size."

(iii) Grouping of Varieties: To have characteristics 1, 26 and 34 as grouping characteristics mentioned and also in that order.

(iv) Table of Characteristics:

Characteristics

2 To read: "Plant: ratio length/width" with the states "very narrow, narrow, medium, broad, very broad"

3 To have the Notes "3, 5, 7"

10, 11, 28 To have the spelling of the example variety "Kokardia" corrected

11 To be placed before characteristic 10 and to read: "Mature leaf: position of maximum width" with the states "towards base (3), in middle (Kokardia, 5), towards apex (7)"

14 To have the word "Evergreen" added at the beginning of the characteristic

20 To have the spelling of the example variety "Mother of Pearl" corrected

23 To have the spelling of the example variety "Fastuosum Flore Pleno" corrected.

(v) Technical Questionnaire: To have in these Test Guidelines and in all others the above mentioned sentences on GMO varieties and on the request of a color photo of the candidate variety included.

Draft Test Guidelines for Anthurium (Revision)

31. The Working Party noted the draft Test Guidelines for Anthurium (Revision) as reproduced in document TG/86/3(proj.) and the comments made by the Editorial Committee. It finally made the following main changes to document TG/42/4(proj):

(i) To receive the same changes with respect to *in vitro* propagation, color photos and GMO varieties as mentioned for Rhododendron.

(ii) Conduct of Tests: To clarify in paragraph 3 "pots with well aired substrate," replace "soil" by "substrate," clarify "Size of pot: 15 cm, number of plants per pot: one" and correct the size of pot for cut flowers to be 21 cm.

(iii) Methods and Observations: Paragraph 3 to read: "All observations should be made on plants that have flowers of maximum size."

(iv) Table of Characteristics:

Characteristics

4 To have the Notes "3, 5, 7"

6, 20 To have the same states as formerly mentioned in characteristic 20 with the exception of state 3 becoming state 2

8 To have the words "shape of" added before "tip"

10 To have the additional states "absent or very weak (1), very strong (9)"

12 To receive an asterisk

14 To have the addition "of middle part"

16 To have the second "position of" deleted

18 To have the spelling of the example variety "Apollo" corrected

21 To be limited to "Varieties with adpressed lobes only"

22 To receive the additional state "obtuse (2)"

23 To have the word "top" replaced by "tip"

28 To have the Notes "3, 5, 7."

Draft Test Guidelines for Norway Spruce

32. The Working Party noted the draft Test Guidelines for Norway Spruce as reproduced in document TG/96/2(proj.) and the comments made by the Editorial Committee. It finally made the following main changes to document TG/96/2(proj):

(i) Subject of these Guidelines: To have the family "Pinaceae" added.

(ii) To receive the same changes with respect to *in vitro* propagation, color photos and GMO varieties as mentioned for Rhododendron.

(iii) Material Required: The last sentence of paragraph 2 to read: Scions should be selected in such a way that expressions caused by topophysis reactions are avoided."

(iv) Methods and Observations: Paragraph 2 to read: "All observations should be made on plants which are five to 10 years old to ensure that the plant material is not affected by topophysis and cyclophysis."

(v) Table of Characteristics:

Characteristics

5, 7, 8, 9, 10, 13 To have the figures in the column "Example varieties" deleted although no example varieties could be indicated so far

5 To read: "Current year's lateral shoot: length"

7, 8, 9 To have the word "only" placed at the beginning of the characteristic to avoid any misunderstanding

12 To have the asterisk deleted

17 To have the second state read: "broad acute."

(vi) Explanations on the Table of Characteristics: The expert from Germany to prepare drawings to explain the different terms "lateral shoot, current year's shoot, twig, etc."

New Methods, Techniques and Equipment in the Examination of Varieties

33. The Working Party recalled the report on the second session of the Working Group on Biochemical and Molecular Techniques and DNA-Profiling in particular (BMT), as reproduced in document BMT/2/9. It also noted that the next session of the BMT will take place from September 19 to 21, 1995.

34. Several experts stated that in the past interest in these methods had been higher but in the last years it had decreased as had the financing of research on these methods. The Working Party reconfirmed the possible usefulness for identification purposes but saw little possibilities for distinctness purposes. The screening of sport varieties was difficult. They could also help in checking whether the correct material had been received (e.g. when imported). Thus the Working Party was interested in the methods but would await further progress in knowledge. For the testing of distinctness in the ornamental field the new methods were not needed as sufficient morphological and physiological characteristics were available.

List of Species in Which Varieties are Tested

35. The Working Party noted that the Technical Committee had requested that document TWO/27/13 comprising a list of species of ornamental plants tested in the UPOV member States should be extended to cover all species of which practical knowledge has been acquired in the member States and that a new questionnaire had been sent out resulting in a new document (TWO/28/10). The Working Party considered the document to be of great use in the contacts between testing authorities. It should be updated at regular intervals, possibly every two years.

Handling of Visually Assessed Characteristics

36. The Working Party noted document TWC/11/12 on the handling of visually assessed characteristics introduced by Mrs. A. Menne (Germany). It agreed that the method described in that document was very useful for the crop expert in helping him (i) to judge whether the number of states of expression used for each characteristic was justified or needed an amendment; (ii) to note which characteristics were correlated and could be reviewed with a view of possibly eliminating one of them and (iii) to check whether the minimum distance

applied was correct or had to be adjusted. The Working Party insisted that the method should just help the crop expert but not force him to changes. The final decision had to remain with the crop expert. The Working Party recommended that the method be considered at every revision of an existing Test Guidelines document, although in practice at present the same review of the existing characteristics would already take place automatically without the application of statistics.

Central Computerized Database

37. The Working Party noted the latest stage of preparation of the UPOV central computerized database on CD-ROM as set forth in Circular U 2229 dated February 24, 1995. The Office of UPOV had invited all of its member States to submit data for the envisaged UPOV-ROM Demonstration Disc by April 15, 1995. It had received data from 15 States (Argentina, Austria, Canada, Denmark, France, Germany, Hungary, Israel, Japan, New Zealand, Netherlands, Spain, Sweden, United Kingdom, United States of America (PVPO and PTO). The Office of UPOV, with the help of experts from WIPO, had checked the data received and had requested, if necessary and possible, corrections from some countries. Afterwards all data were submitted to JOUVE for the preparation of the above-mentioned UPOV-ROM demonstration disc. The Working Party also noted Circular U 2277 containing a list of open questions on the UPOV-ROM Demonstration Disc. All experts were invited to send their comments or proposed answers to the Office of UPOV. After having to correct the data furthermore, it was expected that the UPOV-ROM Demonstration Disc will be distributed in the following weeks.

38. The Working Party welcomed the progress made and hoped to receive the first results of the testing of the Demonstration Disc as well as information on the steps to be taken on the basis of those results at its next session. As the Demonstration Disc would be sent to the Council Representatives of each member State, the Working Party invited all to contact their respective colleagues at national level to see and appreciate the information on the Disc themselves.

Uniformity of Vegetatively Propagated Species

39. The Working Party noted documents TWC/11/16 and TWC/26/19. It also noted that its decision to use in general a population standard of 1% and an acceptance probability of 95% for ornamental varieties had been upheld in the Technical Committee to give more time for clarification of still open questions. A standard paragraph with these figures has therefore not been included in the Test Guidelines adopted last year. After further discussions it reconfirmed its decision of last year to indicate in each Test Guidelines document for vegetatively propagated varieties the population standard, the acceptance probability and the total number of off-types for a given sample size. It agreed to decide on these figures crop by crop. In most cases, a population standard of 1 percent with an acceptance probability of 95 percent would be applicable which would allow one off-type in sample sizes between six and 35. Some experts expressed their concern that in most cases the sample size would be at the lower end of that range leading to a high beta risk.

40. The expert from France gave a short report on a project between experts from France, Germany, the Netherlands and the United Kingdom on the checking of rose mutations. In that project, the four countries had agreed on an exchange of a list of mutant candidate varieties of roses for which applications for protection had been filed, on an exchange of rejections of applications for lack of distinctness of those mutants, on an exchange of all mutations under examination, of all candidates tested for a second year and on a multilateral test of material of several mutants distributed centrally. The main aim was to detect the influence of different climates on the results of the testing. Further results would be reported upon during the next session.

Uniformity of Species/Varieties Which are Propagated Both by Seed and Vegetatively

41. The Working Party recalled the requirement for each variety to be judged according to its method of propagation. It had agreed to accept two different requirements on uniformity within one species, provided that it was not possible to propagate a given seed propagated variety vegetatively. In case it was possible to propagate a given seed propagated variety vegetatively, it foresaw difficulties once the variety was protected. It thus only reluctantly and after long discussions agreed to the basic principle that each variety had to be judged according to its way of propagation and therefore different degrees of uniformity depending on the way of propagation have to be accepted inside one genus or species.

42. The Working Party noted certain difficulties arising in *Bromeliaceae* in the Netherlands where different standards had to be applied to cross-fertilized varieties, self-fertilized varieties, vegetatively propagated varieties (by tissue culture), inbred lines, half hybrids and F_1 crosses. In Israel, *Ranunculus* varieties propagated by seed were not in an equilibrium. In the United Kingdom, in the beginning, seed propagated varieties had variated a lot. That situation had, however, been improved in the meantime. In pelargonium, in Germany, seed propagated varieties showed two types. One type was almost as uniform as clonal varieties while the other type showed some variation. In *Lobelia* next to mainly seed propagated varieties also some vegetatively propagated varieties were produced. In this genus it had so far not been possible to propagate vegetatively a selection of a seed propagated variety.

Discussion on Working Papers on Test Guidelines

Working Paper on Test Guidelines for Iris

43. The Working Party noted document TWO/26/12 and document TWO/28/7 prepared by experts from the Netherlands. It finally made only the following main changes in document TWO/28/7:

(i) Subject of the Guidelines: To have the spelling of some species corrected.

(ii) Material Required: To have "micropropagation" replaced by "*in vitro*" propagation.

(iii) Methods and Observations: To request in paragraph 1 a population standard of 2 percent and an acceptance probability of 95 percent leading to two off-types in 30 plants. To have in paragraph 2 the words "at least 10" replaced by "30."

(iv) Table of Characteristics:

Characteristics

3 To have the word "gutter-shaped" replaced by "U-shaped"

4, 5 To have the word "stem" replaced by "peduncle"

11(b) To have the word "conspicuity" replaced by "conspicuousness"

16(a) To have the word "top" replaced by "tip" and the state "flamed" placed at the end

23(a) To have the state "ovate" placed at the beginning

24(a) To have the word "top" replaced by "tip"

24(b) To have the word "folding" replaced by "undulation"

24(c) To have the word "Corolla" replaced by "Perianth"

27 To have the first state read "near white"

30(a), 30(b), 32, 32(a) To have the word "extension" replaced by "crest"

32(a) To have the words "margin of" inserted before "crest"

36(a) To have the word "type" replaced by "size" and the states reworded to read "small, medium, large."

(v) Literature: To receive the indication of literature from Germany and the Netherlands.

(vi) Technical Questionnaire: To have paragraph 4.2 deleted and the sentences on GMO variety and the request for a photo included.

(vii) The expert from the Netherlands to prepare, before the end of the year, a new draft including asterisks and example varieties.

Working Paper on Test Guidelines for Kangaroo Paw

44. The Working Party noted documents TWO/27/10 and TWO/28/6. It appreciated the proposal to prepare a new draft in February 1996. It asked, however, whether in view of the early date of the next session it would be possible to complete the new draft some time earlier.

Working Paper on Test Guidelines for Limonium

45. The Subgroup of the Working Party noted document TWO/26/14 and a new draft distributed during the session and reproduced as document TWO/28/11 prepared by experts from the Netherlands. It finally made several changes in that new draft of which the expert from the Netherlands globally reported to the Working Party. A new draft would be prepared by the expert from the Netherlands by the end of the year.

Working Paper on Test Guidelines for Chrysanthemum (Revision)

46. The Subgroup of the Working Party noted document TG/26/4 prepared by experts from the United Kingdom and distributed during the session. It finally made several changes in that new draft of which the expert from the United Kingdom globally reported to the session. A new draft would be prepared by her by the end of the year.

47. One of the changes mentioned was to request the applicant in the Technical Questionnaire to indicate not only the variety denomination but also the intended trade name (if already known) as it was the experience that in commerce nobody and often even not the breeder himself would know the variety denomination and everybody would, when making inquiries to the Office, request information on the variety "x" whereby "x" would be the trade name. The Working Party stressed to the Technical Committee that the above information was very important. It would be illusionary to assume that, by not requesting it, one could reinforce the broader acceptance of the use of variety denominations.

48. The Working Party also expressed its concern that the recommendations on variety denominations had been worded in many respects very vaguely which led to the fact that they had been differently interpreted by each State and had often completely missed their intended aim of harmonizing variety denomination between the individual member States. Some member States accepted different series of long denominations all starting with a prefix referring to a given breeder or even with the full name of the breeder sometimes only followed by a qualifying adjective (e.g. "yellow"). Other series were based on the variety denomination of the first variety to which in the case of a mutant another color was added in front of or behind the denomination of the first variety. That was considered to be very unfortunate. Moreover, it was felt that this was partly resulting from the fact that the technical experts were less involved in the acceptance of variety denominations. The Working Party recommended that the administration of the offices should take more seriously the concerns raised by the technical experts. Experts from countries far away from Europe also sometimes received applications for a variety for which in Europe two different variety denominations have been approved leaving them in a difficult position in deciding which of the denomination to accept.

Working Paper on Test Guidelines for Lavender and Lavendine

49. The Working Party noted document TWO/26/11 and document TWO/28/9 prepared by experts from France. It finally made the following main changes in document TWO/28/9:

(i) Subject of the Guidelines: To have the family: "*Labiatae*" corrected and to exclude for the time being *L. stoechas, L. dentata and L. aridis*. The expert from New Zealand will check whether they could be included or not.

(ii) Material Required: To require 20 young plants (less than one year old).

(iii) Conduct of Tests: To have in paragraph 3 the last but one sentence read: "Each test should include a total of 20 plants."

(iv) Methods and Observations: To have in paragraph 1 a population standard of 1 percent and an acceptance probability of 95 percent leading to one off-type in 20.

(v) Grouping of Characteristics: To have the color of the corolla added.

(vi) Table of Characteristics:

Characteristics

1 to 4 To be observed in winter

2 To read: "Plant: shape of lateral side" with the states "rounded (1), tapered (2)"

4 To have the states "absent or very weak (1), weak (2), strong (3)"

5 To read: "Plant: attitude of outer flowering stem" with the third state "horizontal"

9, 6 To have the word "total" deleted

10 To be deleted

11 To have the words "flowering stem without ear" deleted and replaced by "(as for 9)"

16 To have the addition "as from first whorl"

18 To have the word "conic" three times replaced by "conical"

19 To have the second state read "medium"

21 To read: "Ear: ratio length/number of whorls (first whorl excluded)"

22 To have the words "(from base)" deleted

23 To have the words "per ear" deleted

26 To be placed after characteristic 27 and to be split into two characteristics with the states "white, blue, pink" and "intensity" with the states "light, medium, dark"

30 to 33 The expert from France to replace the figures by example varieties and to indicate methods for these and the following characteristics.

(vii) Literature: To receive the following literature indications:

- Armitage, A. M., 1989: "Herbaceoris Perennial Plants." Varsity Press, Inc., Athens, Georgia

- De Wolf, Gordon P., 1955: "Notes on Cultivated Labiates." 5. Lavandula. *Baileya* 3:47-57

- McLeod, J. A.: "Lavender, Sweet Lavender." Kangaroo Press, 1989. Reprinted 1991

- Tucker, Arthur O., 1981: "The Correct Name of Lavandin and its Cultivars (Labiatae)." *Baileya* 21: 131-133

- Tucker, Arthur O. and Karel, J.W. Hensen, 1985: "The Cultivars of Lavender and Lavandin (Labiatae)." *Baileya* 22: 168-177.

(viii) Characteristics on Oil Content: The Working Party noted that one fifth of the characteristics referred to oil and oil content. It agreed to consider the inclusion of these characteristics in the Test Guidelines if a standardized method was available and if the uniformity could be assured through the right sampling. The Working Party considered that in future more industrial crops would come up for protection with similar characteristics of the content of certain substances. These characteristics should not be rejected only because they were performance characteristics.

Working Paper on Test Guidelines for Firelily (Cyrtanthus)

50. The Working Party noted documents TWO/27/5 and TWO/28/4 and made the following main changes in document TWO/28/4:

(i) Material Required: To have the words "meristem culture" replaced by "*in vitro* propagation."

(ii) Conduct of Tests: To have in paragraph 3 the word "Soil" replaced by "Substrate."

(iii) Methods and Observations: To request in paragraph 1 a population standard of 1 percent and an acceptance probability of 95 percent leading to one off-type in 20 plants.

(iv) Characteristics and Symbols: The document to receive an additional paragraph stating that instead of example varieties at present in most cases because of a lack of varieties only species had been indicated which would be replaced by example varieties as and when they became available. The expert from South Africa to indicate the species in question.

(v) Table of Characteristics:

Characteristics

1 To read: "Plant: growth habit" with the states "upright, semi-upright, spreading"

11 To read: "Peduncle: hue of anthocyanin coloration" with the states "red brown, purple"

21, 22 To receive explanations in the existing drawings

22 To have the bracketed addition "if not widest part"

25 To have the states "green (1), yellow (2), light pink (3), dark pink (4)"

29 To have the states "acute, obtuse"

30 To read: "Perianth lobes: curvature" with the states from "absent or very weak" to "very strong"

32 To have the states "same, different"

33, 36 To have the states still to be fixed by the expert from South Africa

39 To read: "Time of beginning of flowering."

(vi) Literature: To receive the indication of literature.

(vii) Technical Questionnaire: To have paragraph 4.2 deleted and the sentences on GMO varieties and on the request for a photo added.

Working Paper on Test Guidelines for Serruria

51. The Working Party noted documents TWO/27/8 and TWO/28/5 and made the following main changes in document TWO/28/5:

(i) Conduct of Tests: To have in paragraph 3 the first sentence read: "... ensuring normal growth in pots with well aired substrate with good water drainage."

(ii) Methods and Observations: To indicate in paragraph 1 a population standard of 1 percent and an acceptance probability of 95 percent leading to zero off-types acceptable in five plants. To replace in paragraph 7 the figure "50" by "10" and to change paragraph 5 to read: "All observations on the floret and the floret bract should be made just before anther dehiscence."

(iii) Grouping of Varieties: To have characteristic 24 deleted from the grouping

(iv) Characteristics and Symbols: To include a new paragraph 3 on the use of species instead of example varieties as for firelily.

(v) Table of Characteristics:

Characteristics

6, 7.1, 7.2, 11, 12(a), 12(b), 14(a), 15, 17, 20, 34, 34(a), 34(b), 35(a), 35(b) To be deleted

4 To have the words "of foliage" added

11 To have the limitation to bipinnate leaves deleted

13 To have the fourth state read: "medium green"

14, 21 To have the states "absent, present"

22 To have the order of the states changed as follows: "greyish, yellowish, greenish, reddish, brownish"

26 To have the word "size" replaced by "diameter"

29 To have the words "well developed" inserted before "involucral" and to have the drawing completed with explanations for characteristics 26 and 36

29(b), 29(c), 32 To have the word "main" replaced by "ground" and the following characteristics to be placed in the following order: 29(a), 30, 31, 34(c), 31(a), 32, 29(b), 29(c), 36, 36(a), 36(b), 35, 33

29(c) To have the words "intensity of pink" included before "color" and to have the states "light, medium, dark"

32 To have only the states: "white to silvery, pale pink, medium pink, dark pink"

36 To have the last state read: "large"

36(a) To have an additional state "greyish (1)" and to have the last state deleted

37, 38, 39, 40 To have the bracket content deleted

38 To have the words "intensity of" added before "pubescence" and to have the states "weak, medium, strong"

39 To have "apical fringe, if present" replaced by "pubescence" and to have the states "greenish, reddish."

(vi) Literature: To receive the same literature indication from "Batten, A." as for Cyrtanthus.

(vii) Technical Questionnaire: To have in paragraph 4.2 "micropropagation" replaced by "*in vitro* propagation," to have "divided plants" deleted and to have the sentences on GMO varieties and on the request for a photo added.

Working Paper on Test Guidelines for Cymbidium

52. The Working Party noted document TWO/28/8 prepared by experts from Japan, went partly through the document and made the following main changes:

(i) Material Required: To have the word "acclimated" replaced by "hardened."

(ii) Conduct of Tests: To have in paragraph 3 the words "20 plants."

(iii) Methods and Observations: To have in paragraph 2 the word "flowering"inserted after the first appearance of the figure "20" and to have in paragraph 5 the words "of flower and parts of flower" inserted after "width."

(iv) Grouping of Varieties: To have the characteristic "Flower: predominant color" deleted as grouping characteristic.

(v) Table of Characteristics:

Characteristics

3 To be placed before characteristic 2

5 To have the order of states "linear, oblong, circular, ovate"; the expert from Japan to prepare drawings for explanation

6 To have the order of states "oblong, circular"

18 To have the first state read: "solitary"

20 to 25 To have the words "Flower stalk" replaced by "Peduncle."

(vi) The discussions were ended at characteristic 20. All experts will send their comments on document TWO/28/8 to Japan before November 1, 1995, to enable the expert to prepare an amended version of the document by the end of the year.

Working Paper on Test Guidelines for Ficus Benjamina

53. The Subgroup of the Working Party noted document TWO/28/2 prepared by experts from the Netherlands and made the following main changes in that document which were reported to the session:

(i) Material Required: To have a new sentence added in paragraph 1 after the plant material reading: "If required by the competent authority 10 plants of commercial size should be submitted in addition to the rooted cuttings to shorten the testing period."

(ii) Conduct of Tests: To have in paragraph 3 the figure "20" replaced by "25."

(iii) Methods and Observations: To request in paragraph 1 a population standard of 1 percent, an acceptance probability of 95 percent leading to one off-type in 25 plants. Paragraph 3 to read: "All observations on the leaf and the stipule should be made near the distal part of the shoot on young leaves as soon as they have reached full size."

716

(iv) Grouping of Varieties: To have characteristics 1, 21 and 23 as grouping characteristics.

(v) Table of Characteristics:

Characteristics

1 To have the Notes "1, 3, 5, 7" and the last state read: "semi-drooping"

3 To have the word "top" replaced by "tip" and the state "7" read "semi-drooping"

5 To have the last state read "brownish read"

11, 12, 15 and 16 To have the words "young leaf" inserted at the beginning of the characteristic

(vi) Lack of time did not allow discussing the whole document. Thus all experts will send their comments to the expert from the Netherlands by November 1, 1995, to enable him preparing an amended draft by the end of the year.

Working Paper on Test Guidelines for Bouvardia

54. The Working Party noted document TWO/28/3 prepared by experts from the Netherlands. Because of shortage of time, it agreed to invite all experts to send their comments on the above document to the expert from the Netherlands in writing before November 1, 1995, to enable him to prepare a new document before the end of the year.

Working Paper on Draft Test Guidelines for Hevea

55. The Subgroup of the Working Party noted a draft for Test Guidelines for Hevea prepared by experts from New Zealand in cooperation with the Indonesian Rubber Research Institute at Sungei Putih, North Sumatra, Indonesia, as distributed during the session. The Subgroup made several amendments to that document which were reported to the session in a summarized form by the expert from New Zealand. The resulting new draft will be reproduced in document TWO/28/12.

Status of Test Guidelines

56. The Working Party agreed that the draft Test Guidelines for Anthurium (Revision), Norway Spruce and Rhododendron (Revision) should be sent to the Technical Committee for final adoption. It agreed that the draft Test Guidelines for Firelily (*Cyrtanthus*) and Serruria should be sent to professional organizations for comments and that the Working Papers on Test Guidelines for the other species mentioned on the agenda should be (re)discussed at its next session.

Future Program, Date and Place of Next Session

57. At the invitation of the expert from Israel, the Working Party agreed to hold its twenty-ninth session in Tel Aviv, Israel from April 15 to 19, 1996 (noon). It was planned that the following items would be discussed during the forthcoming session:

(a) The use of image analysis in the DUS testing of ornamental plants;

(b) Short reports on special developments in plant variety protection in ornamental plants and forest trees;

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

(d) Final discussions on draft Test Guidelines for Firelily (*Cyrtanthus*) and Serruria;

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

(f) Central computerized database;

(g) Discussion on working papers on Test Guidelines:

- Bouvardia (Netherlands to prepare a new draft before the end of the year)
- Chrysanthemum (Revision) (United Kingdom to prepare a new draft before the end of the year)
- Cymbidium (Japan to prepare a new draft before the end of the year)
- *Ficus benjamina* (Netherlands to prepare a new draft before the end of the year)
- Geralton Wax Flower (Australia to prepare a new draft if possible before the end of the year)
- Guzmania (Netherlands to prepare a new draft before the end of the year)
- *Hippeastrum* (Netherlands to prepare a new draft before the end of February 1996)
- Iris (Netherlands to prepare a new draft before the end of the year)
- Kangaroo Paw (Australia to prepare a new draft before the end of the year)
- Lavender and Lavendine (France to prepare a new draft before the end of the year)
- *Limonium* (Netherlands to prepare a new draft before the end of the year)
- *Nerinum* (France to prepare a new draft before the end of the year)

- Ornamental Apple (Revision) (United Kingdom to prepare a new draft before the end of the year)

- Pentas (Netherlands to prepare a new draft before the end of the year)

- Rubber (document TWO/28/12)

- Thymus (France to prepare a new draft before the end of the year)

Visits

58. In the afternoon of September 4, 1995, the Working Party visited the RIKILT-DLO at Wageningen, where it received an introduction by Mr. G. Middendorp (Netherlands) to the handling of applications for breeders' rights from the application stage to the final decision.

59. On September 6, 1995, the Working Party visited the NAKB at Roelofarendsven, where it was welcomed by its Director, Mr. John van Ruiten, thereafter received a lecture on the Nomenclature of Cultivated Plants by Mr. Wilbert Hetterscheid and visited the laboratories and glasshouses of NAKB. In the afternoon, it received an introduction and demonstration on Bromeliad Breeding at Corn. Bak by Mr. Nico Steur.

60. In the afternoons of September 4 and 8, 1995, the Working Party visited the trial fields and glasshouses of the CPRO-DLO at Wageningen where it saw trials on *Agapanthus*, *Anthurium*, Banana, *Bromelia*, *Cypressus*, *Dipladenia*, *Ficus*, *Gerbera*, *Limonium*, *Mandevilla*, *Pentas* and *Spathiphyllum*.

61. *The present report has been adopted by correspondence.*

[Four Annexes follow]

ANNEX I

LIST OF PARTICIPANTS AT THE TWENTY-EIGHT SESSION OF THE TECHNICAL WORKING PARTY FOR ORNAMENTAL PLANTS AND FOREST TREES, WAGENINGEN, NETHERLANDS, SEPTEMBER 4 TO 9, 1995

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[Annex II follows]

DESCRIPTIONS OF ROSE VARIETIES AND IMAGE ANALYSIS

M-H GANDELIN
GEVES Sophia-Antipolis

GEVES : Group of study and control of varieties and seeds

INTRODUCTION

TECHNICAL EXAMINATION OF NEW ROSE VARIETIES FOR :

DISTINCTNESS
HOMOGENEITY
STABILITY

U.P.O.V. : 46 PHENOTYPIC CHARACTERISTICS ON SEVERAL ORGANS

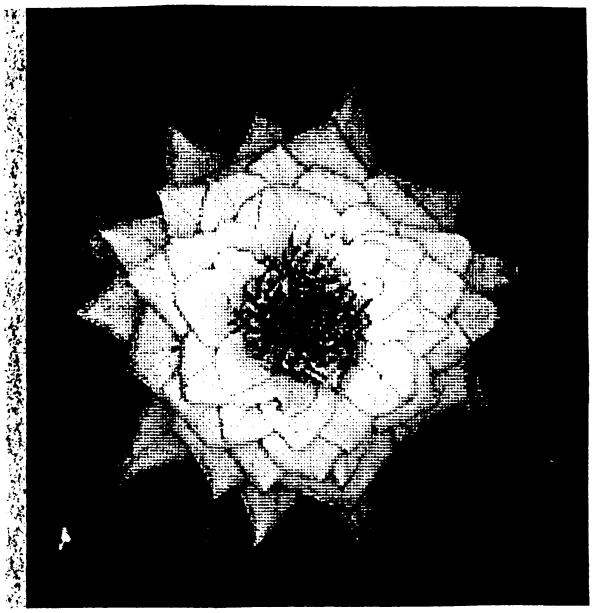
LACK OF PRECISION AND SUBJECTIVITY OF HUMAN OBSERVATIONS

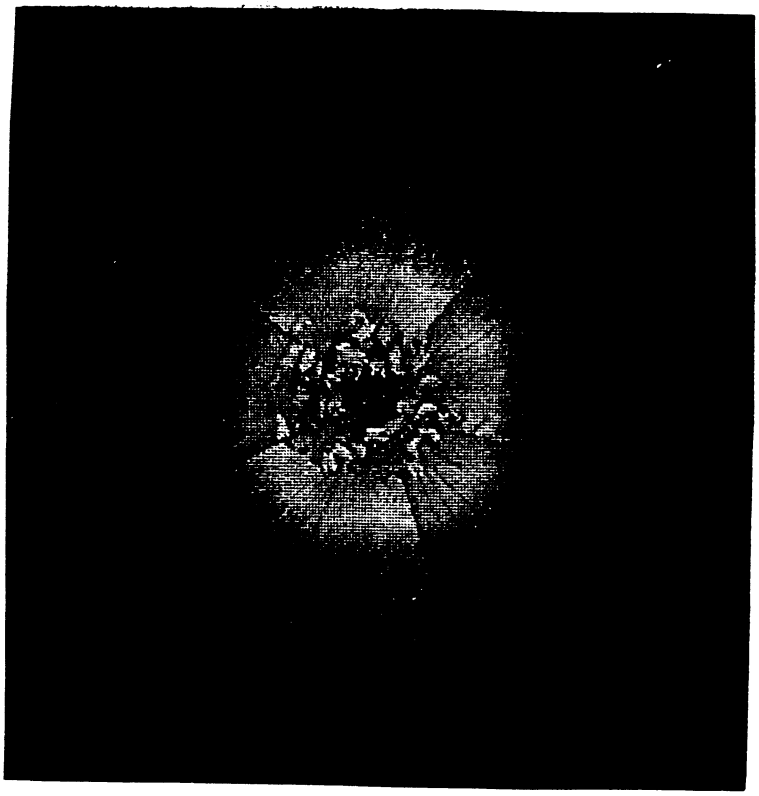
USE OF NEW METHOD : IMAGE ANALYSIS

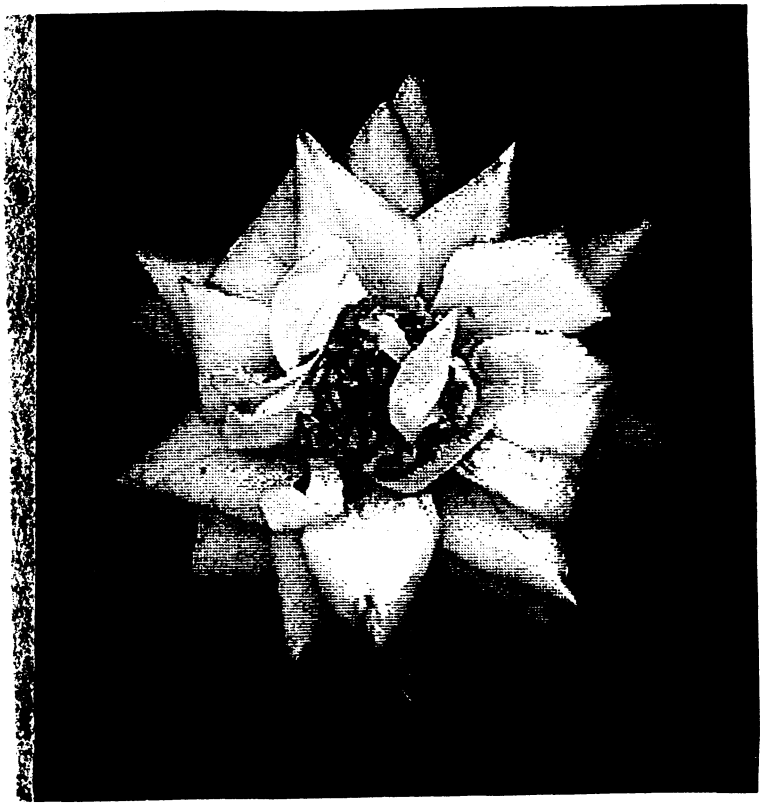
IMAGE ANALYSIS

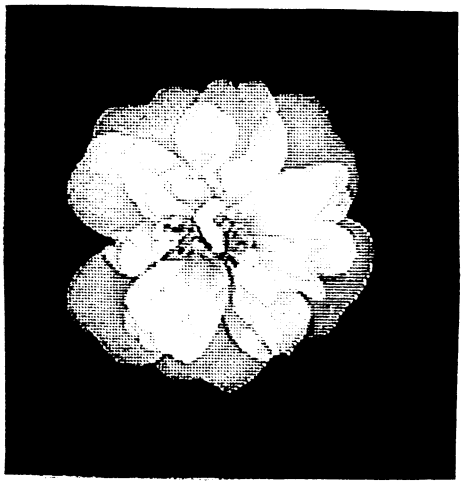
AIM : AUTOMATIC NUMERICAL DESCRIPTION OF FLOWERS AND PETALS

DATA: FLOWERS AND PETALS SCANNER IMAGES









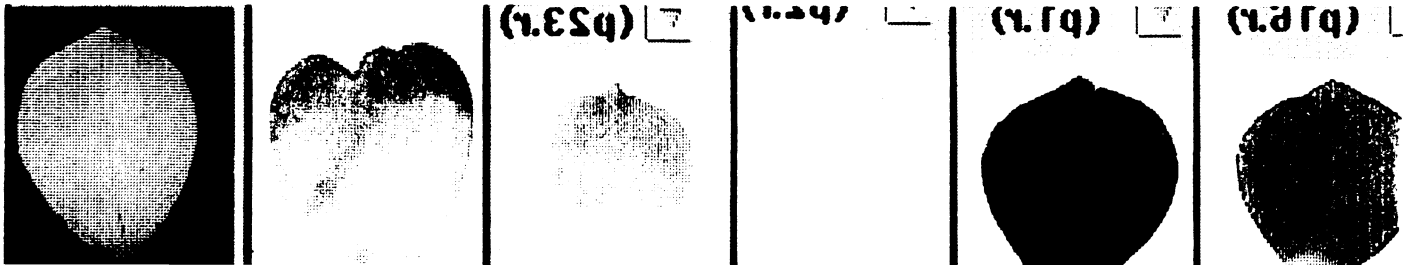


IMAGE ANALYSIS

NEEDS : SET OF MODULAR ALGORITHMS

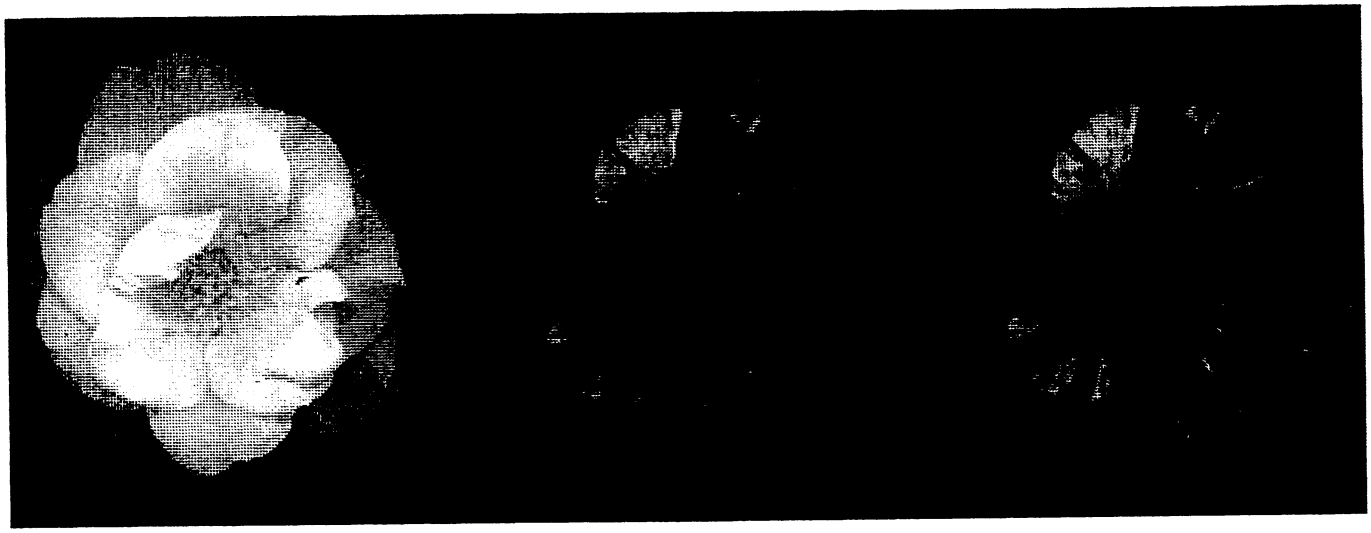
MEANS : TWO STEPS OF PROCESSING

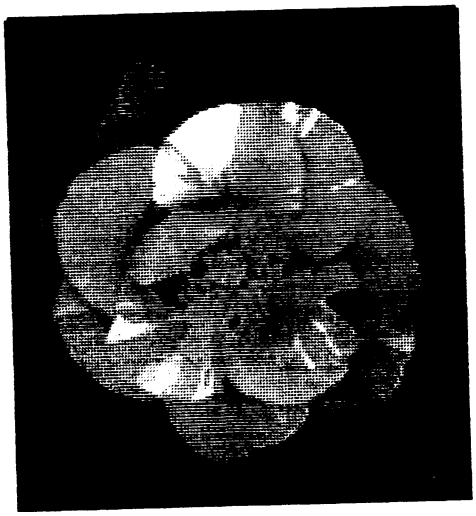
- ISOLATION OF FLOWER OR PETAL
- DESCRIPTION OF FLOWER AND PETAL

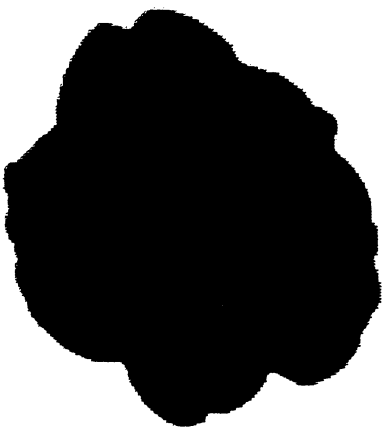
ISOLATION OF THE FLOWER OR PETAL

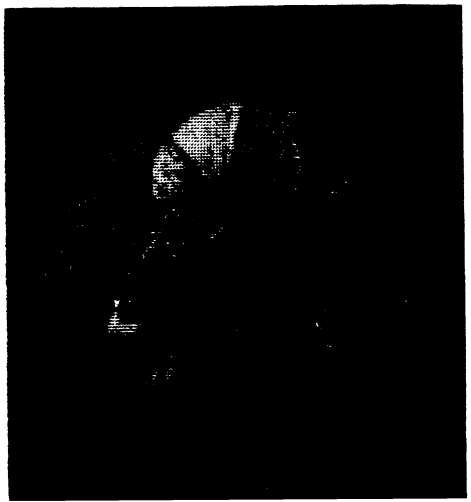
---

* GREY LEVEL IMAGE FORMATION
* ADAPTATIVE AUTOMATIC THRESHOLDING
* MASKING WITH THE ORIGINAL IMAGE









DESCRIPTION OF THE FLOWER

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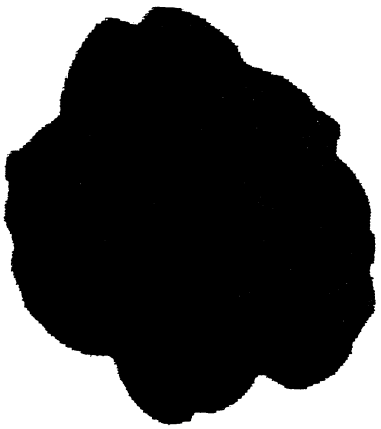
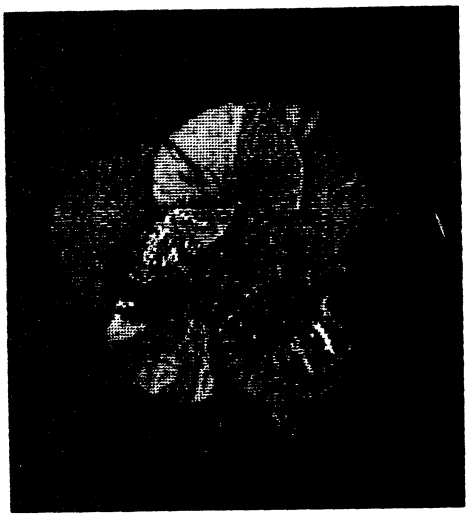
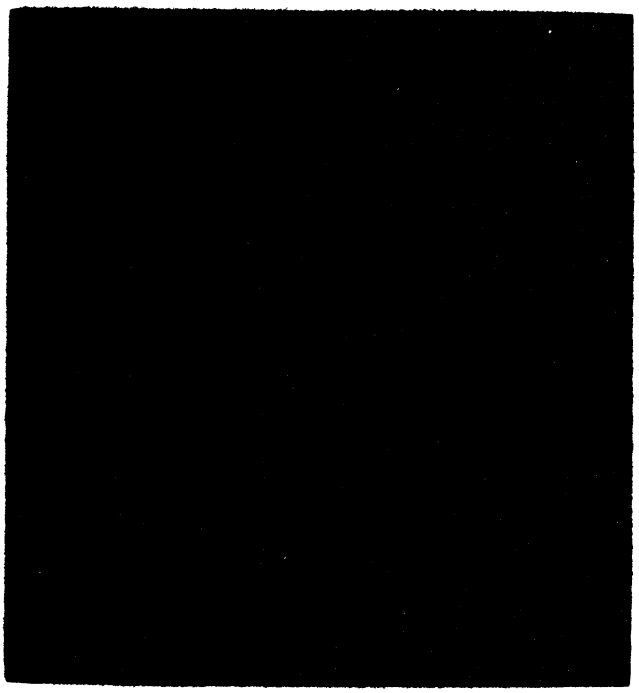
* **GLOBAL MORPHOLOGICAL PARAMETERS**

* **FINE DESCRIPTION OF THE SHAPE**





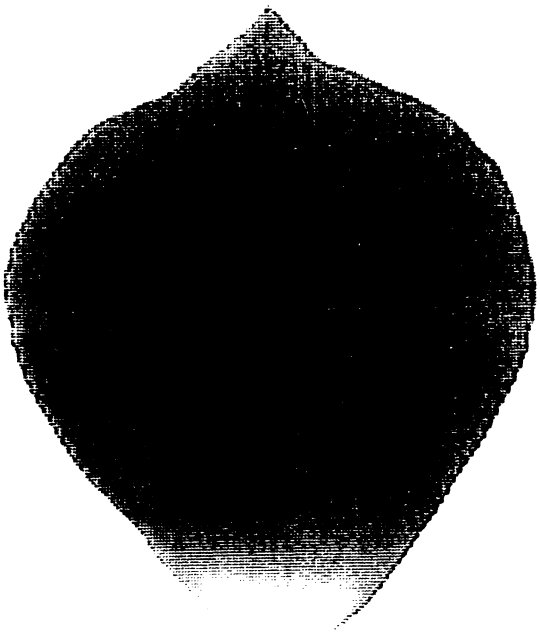


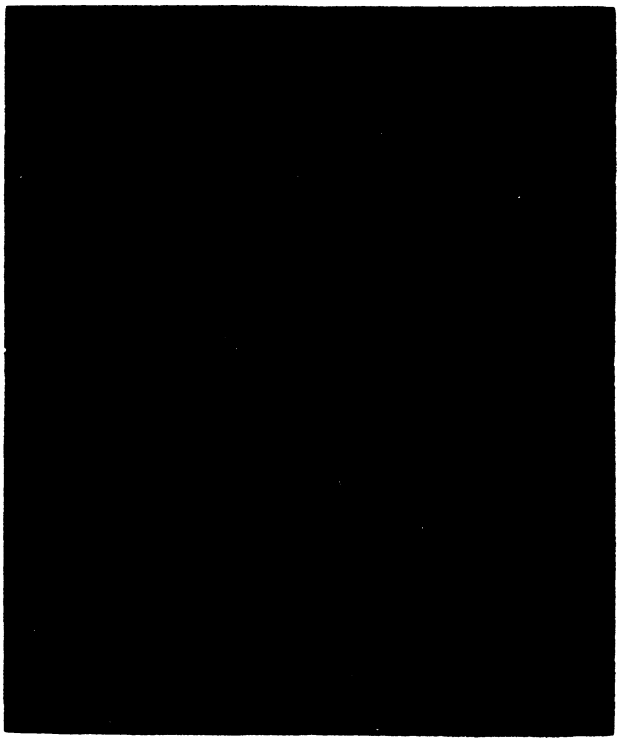
DESCRIPTION OF THE PETAL

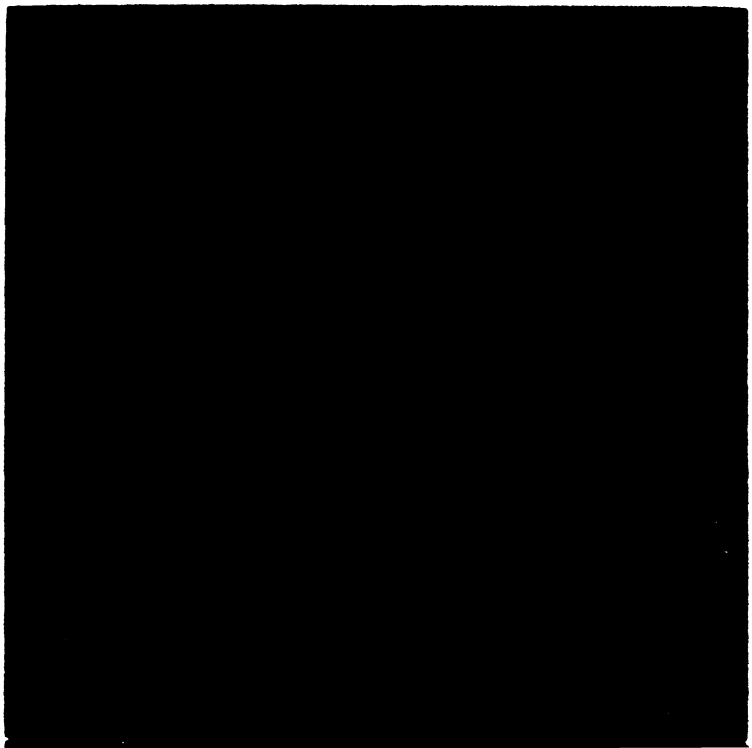
* GLOBAL MORPHOLOGICAL PARAMETERS

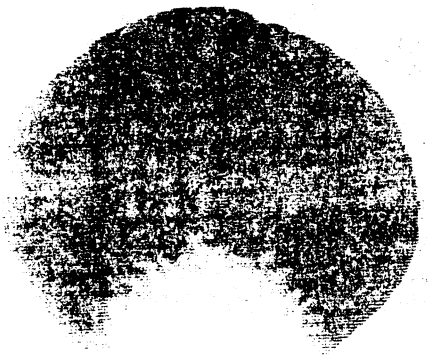
* IF NECESSARY, COLOR SEGMENTATION TO DEFINE AND DESCRIBE THE DIFFERENT ZONES

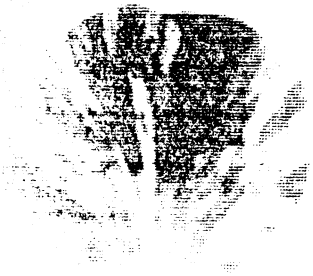
NOTION OF CONTEXTUAL ANALYSIS

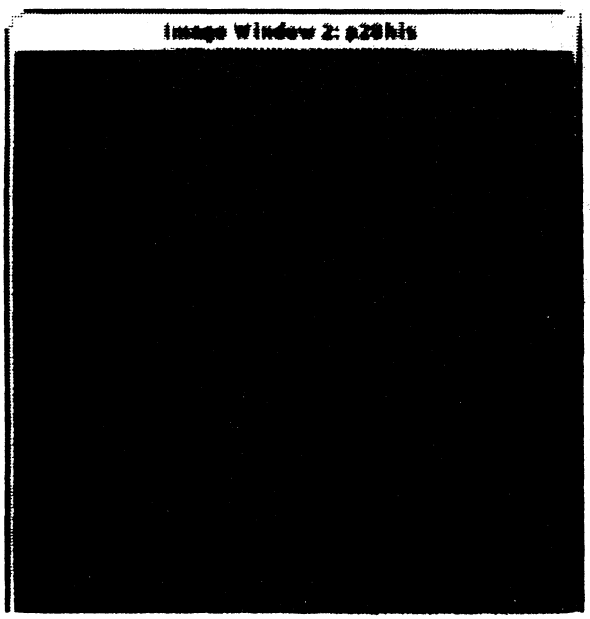








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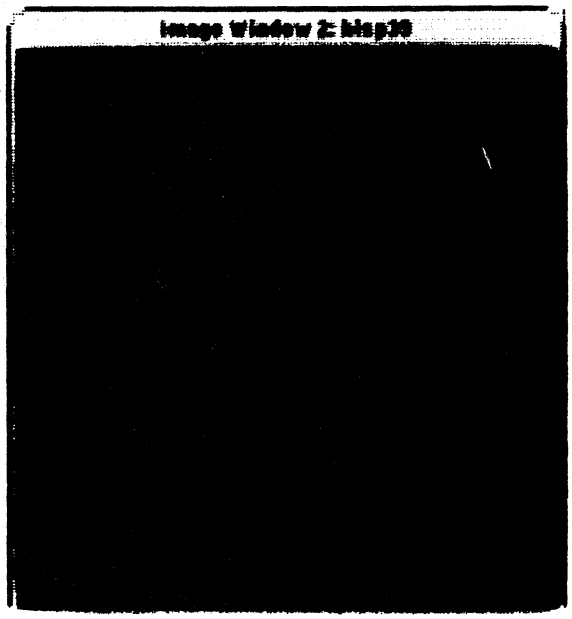
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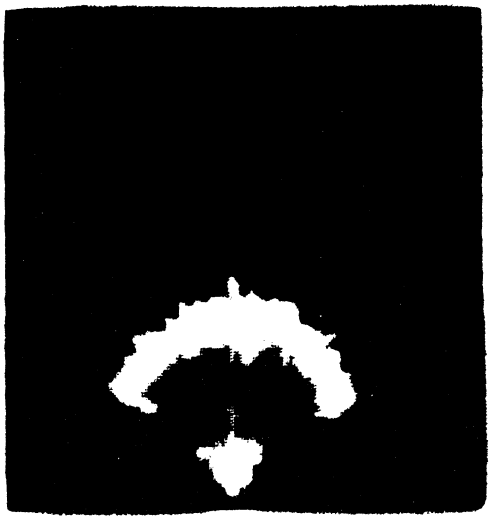

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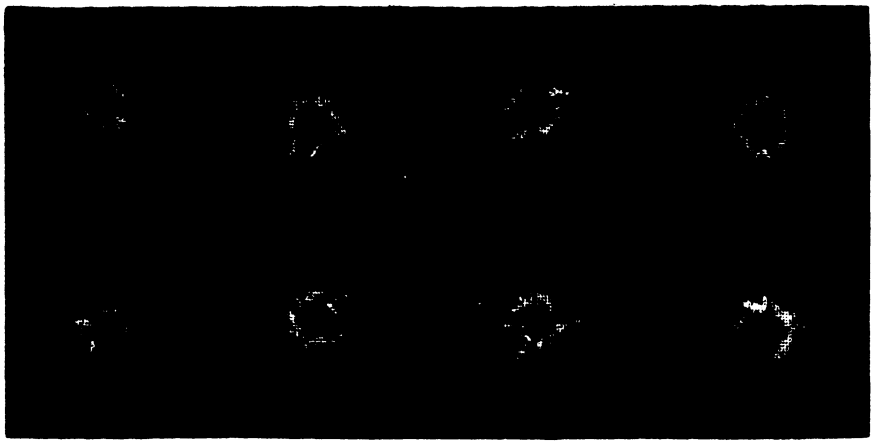

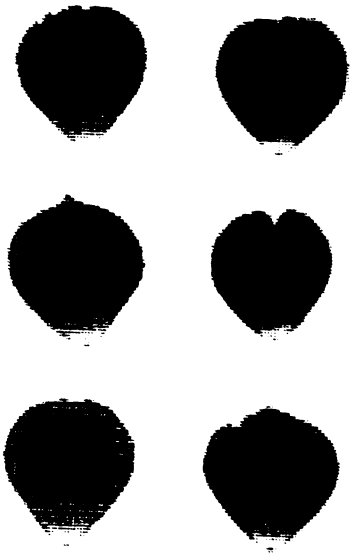

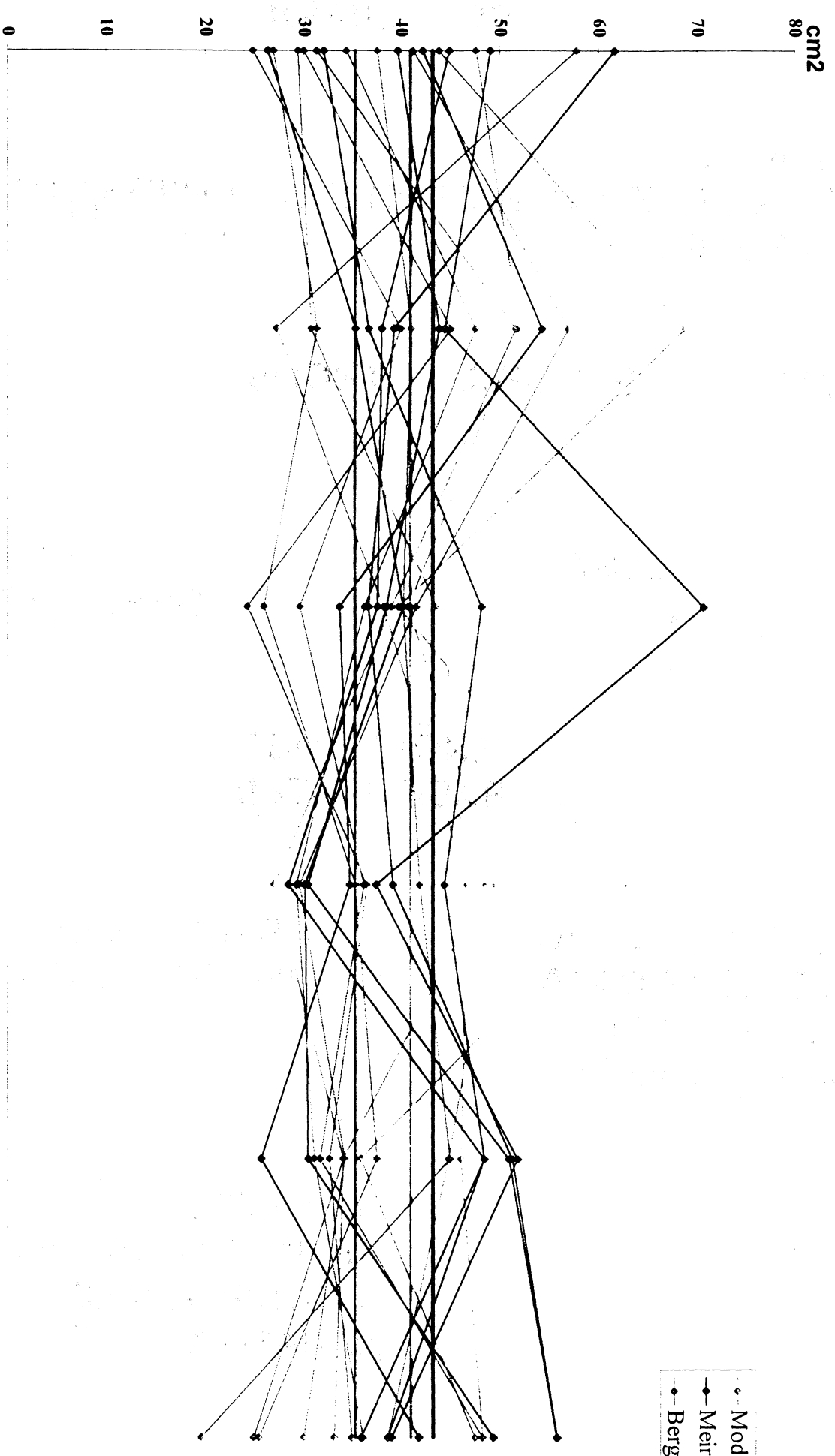
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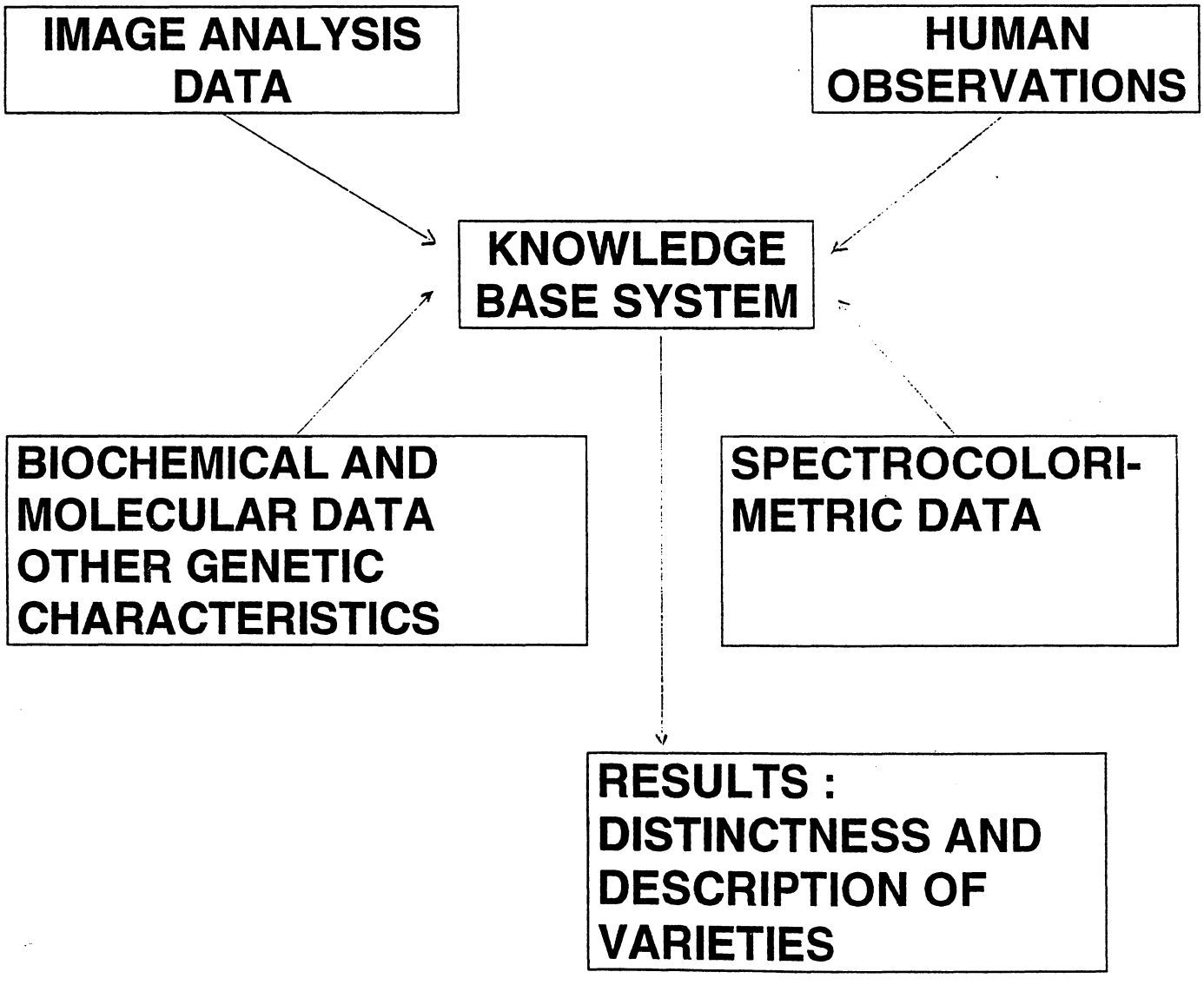
Meirilocra
Bergme

CONCLUSION

FINAL AIM :
OBJECTIVE AND RELIABLE DESCRIPTION OF ROSE VARIETIES

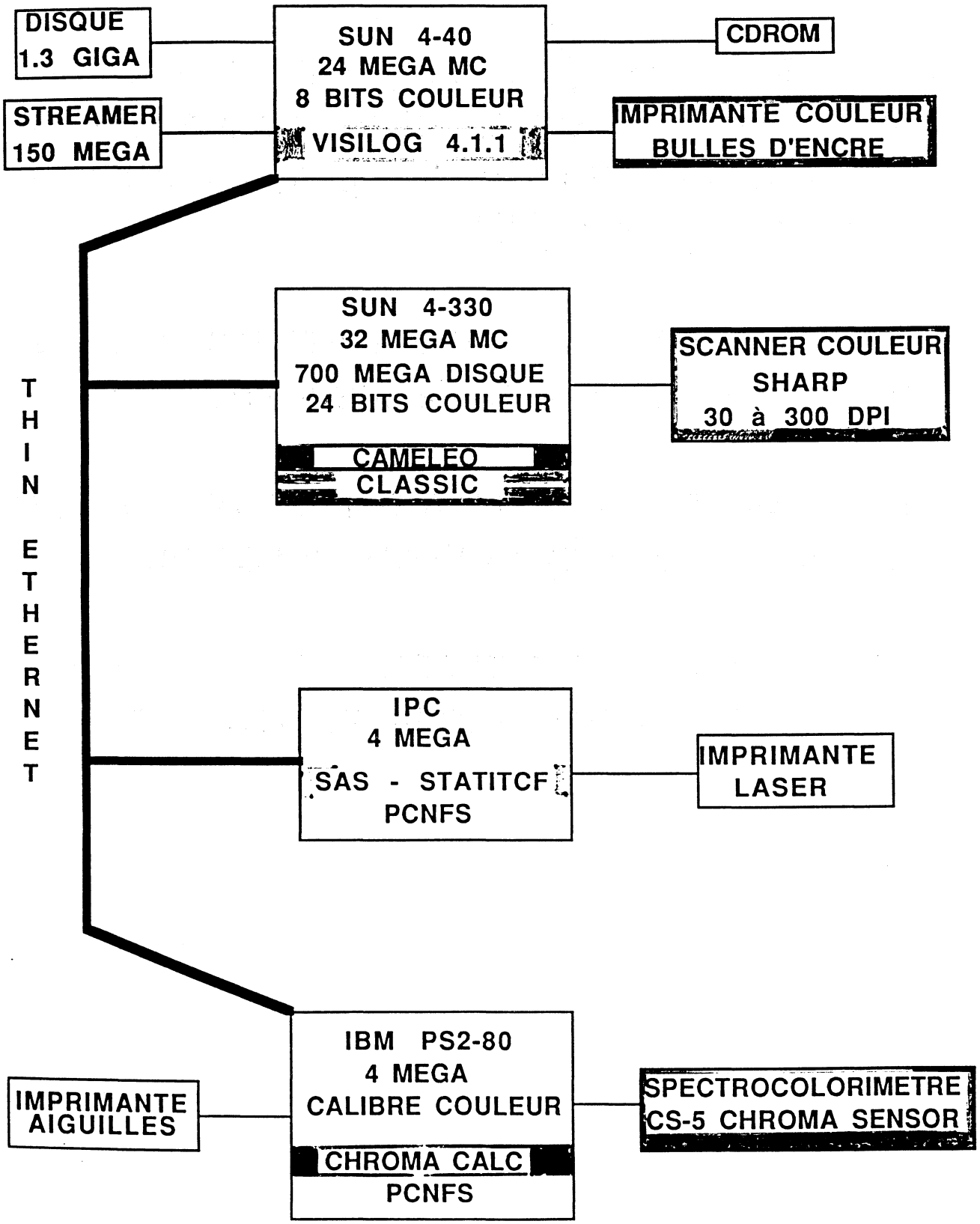
MEANS : SEVERAL METHODS



735

CONFIGURATION INFORMATIQUE

- données d'entrée
- données de sortie
- logiciels d'acquisition
- logiciels de traitement



At GEVES Sophia-Antipolis we perform technical examinations of new rose varieties for distinctness homogeneity and stability.

For this we use forty six morphological and colorimetric, characteristics define by the International Union for the protection of new varieties of plants (UPOV)

The observations concern several organs : flowers, petals, leaves, leaflets and prickles.

The main problem is the lack of precision and the subjectivity of these observations.

We just say, for example, that a flower is very small, small, medium, large or very large.

GEVES has developped an Image Analysis program to make the morphological descriptions objective and reliable.

Our aim is to have an automatical numerical description of the different organs.

Now, we are working on flowers and petals.

We take six plants per variety, three flowers per plant and three petals per flower.

We use a color scanner for image acquisition.

Flowers are simply placed on the surface of the scanner. Petals are glued onto black or white paper.

You can see here several examples of images.

We have built a set of modular algorithms to extract the vision parameters needed.

There are two steps :

the isolation of the flower or petal
the description of the flower and petal.

The first step is common for flowers and petals.

First we build a grey level image from the three channels, red, green and blue images.

Then we compute a threshold value to construct the binary mask of the flower or petal.

In reality, we suppress all noises such as pollen or other dust in the background.

We are now ready to clearly describe the flower or petal.

On the binary mask of the flower, we compute global morphological parameters such as area, perimeter, compacity etc...

On the color mask we compute global colorimetric parameters such as hue, intensity and saturation .

We carry out a precise study of the shape of the flower.
To do this, we compute the radius and diameter with a two degree angle from the center of gravity of the flower.

It is useful to determine if the flower is round or star-shaped and to quantify the irregularity of the flower irregularly rounded.

On petal we also compute global morphological parameters such as area, perimeter, compacity etc...

To precisely study the shape of the petals, we determine an axial reference with the vertical and horizontal axes from the center of gravity.

Then we can compute axial width and height, position of the maximum width in relation to the height, area symetries or assymetries of the different halves: right-left and top-bottom.

Two density curves are also computed : these are the plots of the lines of the color image along each axis.

We use these curves to detect different color zones on the petal.

For example, you can see here the peak of the basal spot.

If there are different color zone, we construct the internal histogram of the petal and we compute a threshold to separate the diffferent zones as here.

The problem can be more or less complex, one, two or three threshold values, but the method can be very precise.

After, we can compute the number of zones, their position, area, shape, hue and saturation.

An important problem is the measurement of the variability of shape and color distribution between petals, flowers and plants.

Here you have three petals per flower and the two flowers are cutted the same day on the same plant.

Here I have just shown you results on Image analysis but our program is more ambitious.
One single method is not suffisant to obtain reasonable results on distinctness and to have a really good description of varieties.
We want build a knowledge base system with input data of several kind : human observations,image analysis, spectrocolorimetric, biochemichal or genetical data.

[Annex III follows]

TWO /28/1 WAGENINGEN, SEPTEMBER 1995

TOP 3. The use of image analysis in DUS testing of ornamental plants

Paper On The Use Of Image Processing At The Bundessortenamt

1. Image Processing

Image processing can be divided into image recording and image analysis.

Image recording means that images of plants or parts of plants are taken and stored either analogue or digitally. With this the so long used slides can be replaced. It is possible to compare varieties side by side on the screen, together with the data which were assessed during the DUS test. Furthermore it is possible to reduce the number of varieties to be grown in the test by more precise selecting of existing varieties which are similar to candidate varieties.

The other part of image processing is image analysis. With this measurements of plants or parts of plants are done by a computer program. In this case the images are only necessary for the measurements and they do not need to be stored. Image analysis shall in the future substitute some manual measurements, saving time because one image can be used for several measurements. Furthermore new characteristics may become available, for example by calculating the leaf area.

2. System configuration

Images are taken by a colour video camera from Sony. The camera has a high resolution. The image is checked with a special Trintron monitor also from Sony. The images are stored on a videodisc as analogue video signal. This laser videodisc recorder is a so-called WORM-device (Write Once Read Multiple).

We decided to record the images in analogue form outside the computer on a separate device, because:
1) A digital conversion reduces the image information, what can lead to a quality reduction. Specially the original reproduction of colours can be influenced.
2) Digital uncompressed colour images need a lot of space on a hard disk. One videodisc can store 72 000 video images.
3) Time needed to access one image is half a second.
4) The storage of images is not depending on the used computer- or database system. So the compatibility is ensured for the future.

The laser videodisc recorder is connected by a serial cable with the workstation. A program written in C, which can be integrated into a database program, controls the videodisc recorder. Our computer configuration consists of a local area network which connects some UNIX server. One server stores the databases with information about the varieties.
For simultaneous looking at images and data of varieties on the computer screen, the images have to be converted into digital form. For that a so called frame grabber is used, which can convert the live video image from the camera or a stored image from the videodisc to digital form. The frame grabber is connected with the workstation via SCSI. To find similar varieties it is important to see two or more images on one screen. This is only possible on the computer monitor, the control monitor cannot split the screen without special hardware.

For image analysis we can use the direct connection from the camera via frame grabber to the computer. For that it is not necessary to store images on the videodisk.

747

3. Equalities and differences between image recording and image analysis

For image recording and image analysis we need the images from plants and parts of plants and a computer.
The computer has different tasks in image recording and image analysis. Within image recording the computer links images and data of variety together. Within image analysis a computer program measures the characteristics on the image, and the results are written into the database.

Within image recording the image is important, it is stored on the videodisc in analogue form. To show data and images together on one screen, the images have to be converted to digital form temporary.

Within image analysis we are only interested in the results of the measurements. Therefore it is not necessary to store the image. But recording images on the videodisc is possible and convenient, if the calculation will be done later or the image will be needed in an other context.

4. First results

We started one year ago with collecting information about the hardware, which is necessary for image processing. For two months the hardware is available. The program, which controls the laser videodisc recorder is also working now. Due to the fact that the equipment is only two months old we are still collecting experiences to handle it.
Our biggest problem at the time being is to get images with original colour reproduction. An important influence on the colour has the lighting. Up to now we got the best results with lamps, which have nearly the spectral distribution of sunlight (total spectrum lamps).

Unfortunately there are some colours that cannot be seen on the monitor like in nature. To explain this phenomenon we have to lock at the colour reproduction on a monitor. The colours on a monitor are produced by 3 pixels of red, green and blue phosphorus. The 3 colours build the edges of a triangle in the colourspectrum. Only the colours inside the triangle can be produced by the phosphorus pixels. Our experiences confirm, that there are problems with orange and purple colours.
But nevertheless the differences between two similar colours are visible.

We are now working on a program which makes image recording more comfortable. This program will handle the recording and searching of images on the videodisc and the link between the recording numbers and the application numbers of the varieties. This program links several databases, controls the videodisc recorder and realizes the display of the data of varieties and their images together on the computer monitor.

With image analysis we have not started yet.
Our next step will be to decide, which program is most useful for our purposes. Because the program has to run under HP-UX workstation we have only the choice between SCIL-Image and Khorus. In next time we will test these two programs.

After that the characteristics, which have to be measured must be defined. Then we will realize programs to calculate characteristics for the species Pelargonium and rye. With Pelargonium we will measure leaves, flowers and petals. Possible characteristics are length, width and area. With rye we will calculate the amount of grain.

Kathrin Siebert, Bundessortenamt

[Annex IV follows]

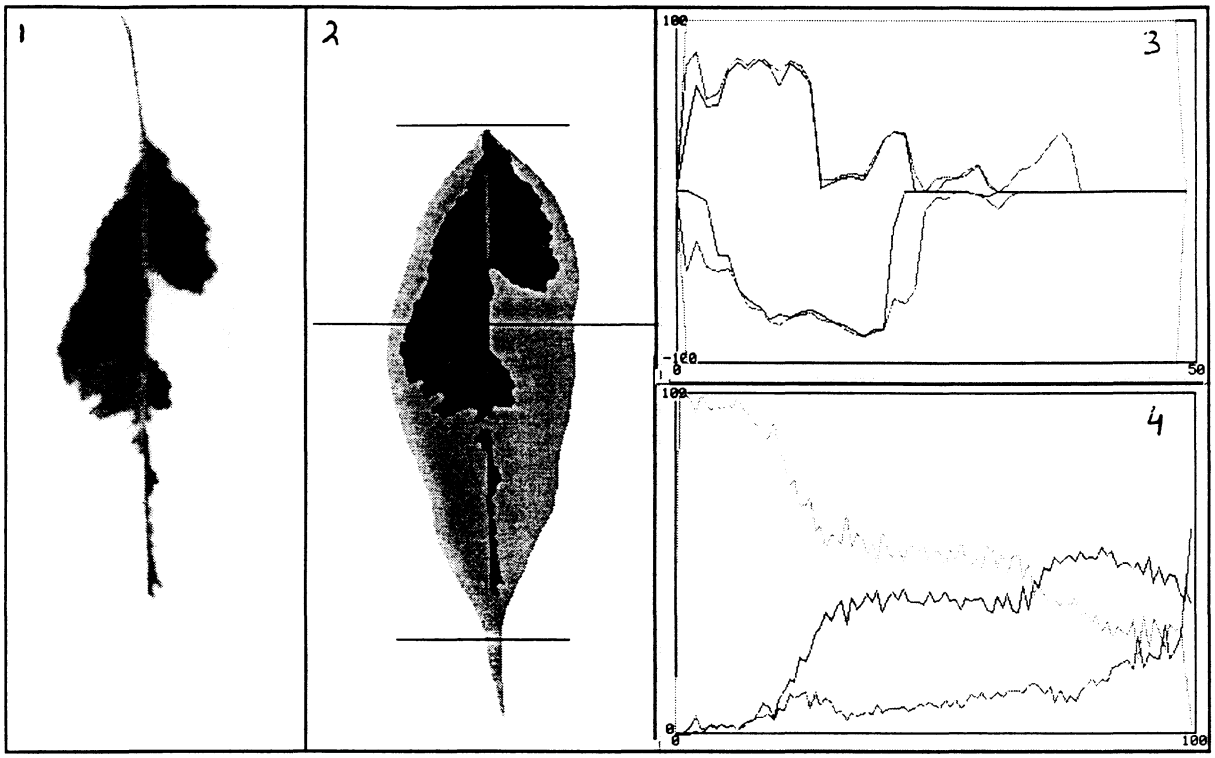
ANNEX IV

Measuring the distribution of green levels on ficus leaves with the aid of image analysis.

After research on measuring features described in UPOV guidelines, image analysis research at CPRO-DLO is now also focused on measuring features which are hardly to measure visually.
CPRO is doing research to measure the distribution of colours on leaves. In this study ficus leaves are chosen as model crop.
To describe the distribution of the different green levels on a ficus leaf 2 possibilities are studied.
The first approach is based on measuring the contours of each different green coloured area on the leaf as shown in figure 1. The three different green levels in the leaf of this figure are represented by different grey values. A histogram is obtained from the grey values of the leaves, containing the number of pixels for each grey value. Three succesive peaks are found in the histogram and a grey level between the peaks is used as a threshold. Hence 3 green levels can be represented using two thresholds as shown in figure 2.
At 50 equally distributed cross sections on the leaf the distance between the edge of the leaf and the first pixel of each green level is calculated. This is calculated for both the left and right side of the leaf. In figure 3 these distances are normalised and plotted. The values on the y-axis represents the distances running from - 100 (the left edge) to 100 (the right edge). The x-axis represent the 50 cross sections running from the petiole to the top of the leaf. The result is an normalised image which describe the contours of each green level on the leave.
Beside contour description there is also the possibility to describe the distribution of the 3 green levels. This is based on calculating the shortest distance to the background for each pixel in the object (distance transform). These distances are also normalised to values running from 0 to 100. Pixels on the edge of the leaf have distance value 0 while pixels in the middle of the leaf have distance value 100. For each distance value the relative amount of each green level on that distance is calculated. The result of this calculation is plotted in figure 4. In this figure the x-axis represents the distance from the edge (value 0) to the middle of the leaf (value 100). The y-axis represent the relative amount for each green level.
Because the results are normalised it is possible to calculate the mean and variance for each variety which gives the possibility to compare the results with other varieties.
Beside description of contours and distribution of the green levels this image analysis application is also measuring the total amount and number of spots of each green level. The width, the symmetry between the left and right side of the leaf and the length of the leaf, petiole and leaf top are also calculated.

The research on image analysis for DUS-testing at CPRO-DLO has resulted in a number of applications for several crops (mushroom, flax, onion, French bean, cucumber, carrot). The results have indicated the following:

- Using only two or three characteristics, such as length and width, can already lead to a considerable reduction in the time required for measuring. This is especially true if a specially developed conveyer belt with an Illumunition housing is used for the recording.
- image analysis can become even more beneficial when many characteristics (including new, special image analysis features) are measured simultaniously, such a size, shape, texture and colour.
- The costs of the equipment are relatively low, but the time required for development is considerable.
- Although image analysis can eliminate errors, such as typing errors and differences between observers (subjectivity), it can introduce new errors. Therefore special care should be taken when recording the objects.
- Higher accuracy of measurements is for many characteristics not required. Most variation encountered is not due to measurement errors, but to biological variation within a variety.
- Shape analysis by computer might be helpful in creating shape classes.
- Digital images can be stored in a database, which can serve as a reference collection. Searching in this database using image analysis features can narrow down the number of comparisons in the field considerably.



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