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UPOV

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INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS

GENEVA

TECHNICAL WORKING PARTY FOR FRUIT CROPS

Twenty-fifth Session

Napier/Rotorua, New Zealand, September 19 to 24, 1994

REPORT

adopted by the Technical Working Party for Fruit Crops

Opening of the Session

1. The twenty-fifth session of the Technical Working Party for Fruit Crops (hereinafter referred to as "the Working Party") was held at Napier and Rotorua, New Zealand, from September 19 to 24, 1994. The list of participants is given in Annex I to this report.

2. Mr. Bill Whitmore, Commissioner of the Plant Variety Rights Office, welcomed the participants to New Zealand. The session was opened by Mrs. Elise Buitendag (South Africa), Chairman of the Working Party.

Adoption of the Agenda

3. The Working Party adopted the agenda of its twenty-fifth session which is reproduced in document TWF/25/1, after having agreed to include after item 10, an item 10(a) on resistance as requested by the Technical Committee and an item 10(b) on species of which practical technical knowledge had been acquired.

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

4. The Working Party received from some of its experts short reports on recent developments in their countries. The expert from New Zealand reported that 50% of the applications in the fruit sector were made for apple varieties. For the testing of fruit varieties, DNA profiling methods were under consideration. The expert from the United Kingdom reported on problems arising

from the increase in requests for the testing of apple varieties from several countries, as the reference varieties were not completely identical. Especially in cases of mutations, the validity of test results could be questioned if the closest variety was not present at the testing station. It was important to keep a close communication among the testing experts in order to avoid such difficulties. The best solution would, however, be to agree on one single testing center for a given region or climate. For the fruit and leaf shape of apples, 2.000 varieties had been screened this year with the help of image analysis in order to build up an apple data base. The expert from Germany reported on the increase of applications for apple and strawberry varieties. Because of the frequent misuse in commerce of the denominations of apple mutants, an information exchange between offices was important in order to be informed of the work of other offices. Now that an agreement on the text on the Council Regulation (EC) on Community plant variety rights had been reached, it was important that the criterium of essential derivation should be fixed in national laws in order to avoid "copy breeding" mainly through the reselection of varieties from other countries. The expert from Japan reported on a 30% decrease in applications for fruit varieties, compared to the preceding year. The expert from France reported on a rapid turnover in fruit varieties. Even before the end of the testing period about 25% to 30% of applications are withdrawn. Biochemical markers were under study to facilitate the identification of varieties, especially for interspecific hybrid rootstocks. Annex II to this report gives further details. The expert from Italy reported on the reorganization of the fruit testing in his country, now performed in only seven institutes. A new organization had been created which would be involved in the diffusion of varieties to nurseries, especially to ensure virus-free material. The expert from the Netherlands reported that in his country the testing of fruit varieties was of less importance since all their testing had been contracted to experts of other countries. The expert from South Africa reported that because of increase of applications in the ornamental field after the political changes, work on fruit varieties will have to be reduced. More work would have to be performed on the premises of breeders and more panels would have to be involved. New methods such as RAPP would be studied with caution.

Important Decisions Taken During the Last Sessions of the Working Party, the Technical Committee and the Technical Working Party on Automation and Computer Programs

5. Mr. Thiele-Wittig gave a brief report on the main items discussed during the previous session of the Technical Committee and referred participants needing further details to the full report reproduced in document TC/30/6. The main results of the TWC are reported under items 7 and 8 of the Draft Agenda. Concerning the question of cooperation in the testing with breeders, the Working Party considered that, in the field of fruit varieties, such cooperation would be exception. For some minor species with few varieties and few applications, it was, however, also possible and already used. The lack of a representative reference collection with breeders would be the main reason for such a limitation.

Color Observations

6. The Working Party noted document TWO/26/17, containing a draft report of the TWO Subgroup Meeting on Color Measurements held in Antibes, France, on September 30 and October 1, 1993, and of document TWO/27/3 containing a proposal for the grouping of the RHS Colour Chart. The Working Party also noted the improvements reached in the United Kingdom on the recording of the fruit color of apple clones, with the help of Minolta equipment, and on their

analysis using discriminative cluster analysis, and on the grouping of fruit color mutants in a dendrogramm. The method looked promising although some effort had still to be made in order to find the right statistical approach and to make it reliable. It was not intended to use the method directly for distinctness testing. It should only be a tool to describe the difference observed visually by the expert. Annex III to this report reproduces the procedure for the evaluation of a mutation/sport variety to assess uniformity and stability.

7. The expert from the Netherlands reported on the use of image analysis in his country for the storage of data of ornamental varieties. Annex IV to this report presents details on the equipment used for that purpose.

8. Annex V to this report reproduces an article of Mr. A.G. White on "The Measurement of Red Colour of Apple Fruit Using Digital Imaging" as explained by the author during a visit to his office.

New Methods, Techniques and Equipment in the Examination of Varieties

9. Mr. Dodd (United Kingdom) briefly reported on the main items discussed during the second session of the Working Group on Biochemical and Molecular Techniques and DNA-Profiling in particular (BMT) , referring to the report reproduced in document BMT/2/9 Prov. Mr. Thiele-Wittig completed that report highlighting the plans of the Working Party for its next session. Mr. Dodd emphasized that in view of the availability of so many morphological characteristics the need of these methods in the field of fruit varieties were reduced. During its visits, the Working Party received an introduction to the fingerprinting of apples. It entirely supported the position that in the near future it would not be possible to use DNA profiling to establish distinctness. Instead, more effort should be made to develop the observation of morphological characteristics using new tools, for example, image analysis. The observation of pollen and its surface might well be developed for the purposes of distinctness. Image analysis might also speed up the number of other morphological observations.

10. In this connection, the Working Party also discussed the use of combined characteristics and multi-variate analysis. It was aware of the fact that with characteristics such as shape, vigor or ratio it already used combined characteristics. It concluded that a combination of characteristics was acceptable as long as it was possible to describe the difference obtained through such a combination, or to interprete the results, and as long as the breeder would be able to keep the variety homogeneous in respect of the combined characteristic.

11. The Working Party studied in detail document TWF/25/9, prepared by experts from Germany which made proposals for population standards and acceptance probabilities for off-types for several fruit species. Mr. Spellerberg (Germany) explained that, as a first step, the population standard had been fixed on the basis of previous experience with existing varieties and on the breeding history of varieties and the mutability of the species concerned. Only thereafter was the acceptance probability considered. The Working Party finally agreed to fix the population standard at 1% for all species mentioned in the document, including those for which Test Guidelines had been completed during the current session, with the exception of apple rootstocks for which 2% was agreed upon.

12. The Working Party contested, however, the application to vegetatively propagated species of the calculation of the beta risk. According to its

previous experience, it was impossible for the risk to be as high as indicated. The experts would approach their national statisticians in order to discuss the question and to find out the reasons for its non-applicability. It could be that for vegetatively propopagated varieties some of the assumptions of the statistical method were not fulfilled. The possible occurance of off-types in vegetatively propagated varieties would not follow the normal distribution, but only one side of it. Only positive mutations would be observed, negative ones would pass unnoticed. Uniformity tests could be supplemented by growing further plants on another test site or by visiting the applicant and checking a larger population.

13. The beta risk would thus have to be redefined for vegetatively propagated varieties. It was not possible to apply the method developed for seed propagated varieties. "Off-type" would also have to be defined. In this respect the Working Party also studied document TWO/27/6 and asked the following questions: Was a partial mutation already an off-type? Where was the borderline, the minimum distance, in a plant? The handling of obvious admixtures should also be harmonized. Do they have to be treated as normal off-types? The Working Party would need to come back to this subject during its next session.

14. On that occasion it would also further discuss the proposal from experts from New Zealand, contained in document TWO/27/4, in order to define an upper and lower level of off-types and to use those "confidence limits" for the judgment of uniformity.

UPOV Central Computerized Data Base

15. The Working Party noted the history of the discussions concerning a possible UPOV central computerized data base on CD-ROM as set forth in document CAJ/32/2-TC/29/2 and Circulars U 2047 and U 2067 and that the Council, during its session in October 1993, had approved the preparation of a prototype for such a UPOV data base. It also noted the UPOV format for the transmission of bibliographic data on plant varieties to a UPOV central computerized data base on CD-ROM, as reproduced in document TWC/12/8. That format, with slight amendments, had been passed to a firm in order to develop a prototype on the basis of data supplied in it by the offices participating in the ad hoc Working Group. The prototype is expected to be ready for checking by October 25, 1994. This would allow the experts of the ad hoc Working Group about two weeks to verify it and to submit their findings to the Council of UPOV who would take a decision on the future data base at its next meeting on November 9, 1994. The Working Party welcomed the progress achieved and hoped to receive the first results of the testing of the prototype as well as information on the steps to be taken on the basis of those results at its next session. The fruit experts would welcome its early establishment as they urgently needed such a data base. They expressed the hope that all member States would eventually participate in the data base so that all varieties might be covered.

Final Discussions on Draft Test Guidelines for Japanese Pear

16. The Working Party noted document TG/149/1(proj.) and the fact that no comments had been received in writing on that document. It therefore made only the following main changes in that document:

(i) Methods and Observations: Paragraph 3 to apply to the tree, the vegetative bud and the flower bud.

(ii) Table of Characteristics:

Characteristics

10 To read: "Branch: number of spurs"

11 to 16 To have "Foliar bud" replaced by "Vegetative bud"

20 To be deleted

21 To have the last state read: "broad cordate"

22 To apply to the tip and to have the second state read: "acute"

23 To have the third state read: "rounded"

24 To read: "Leaf blade: incisions of margin"

25 To have after this characteristic the following characteristic 25a inserted: "Leaf: width" with the states "narrow, medium, broad"

27 To have the states "small, medium, broad"

29 To have "lower" replaced by "outer" and to be observed "(at ballon stage)"

30 To read: "Petal: color of inner side of fully opened flower"

34 To have the word "predominant" deleted and to have the states "5 or less than 5, more than 5 up to and including 6, more than 6 up to and including 7, more than 7"

38 To have the words "presence of" deleted

54 To have the last two states read: "ovate, broad ovate"

60 To have the states "weak, medium, strong"

66 To have the second state read: "narrow ovate"

68 To read: "Time of beginning of vegetative bud opening (10% of buds open)"

70 To have the bracketed content and the example variety for state 1 deleted

72 To have the bracketed content deleted

74 To have the asterisk deleted

75 To be observed under controlled temperature and humidity conditions

77 To be deleted

(iii) Explanations of the Table of Characteristics: To have the drawings for Ad. 22, Ad. 23 and Ads. 40-43 amended and the method for Ad. 76 completed with the states and example variety from the Table of Characteristics.

(iv) Literature: To have additional literature added.

17. On the occasion of the discussions on draft Test Guidelines for Apple and for Japanese Pear, the Working Party had detailed discussions on the number of characteristics to be included in the Test Guidelines, and on the use of per-

formance characteristics for distinctness purposes. Having noted that in the past chracteristics had been included which thereafter had not been used or needed for the establishment of distinctness, the Working Party agreed that on the occasion of the revision of Test Guidelines it would reduce the number of characteristics and focus on the key characteristics and those actually used in the member States. Although the asterisk had been developed to cover the key characteristics, the inclusion of non-asterisk characteristics in the Test Guidelines would lead to a temptation to observe more chracteristics than necessary, if only for making comparisons with descriptions from other States, which might have used those characteristics.

18. In view of the effect of environment on pure performance characteristics, even if they fulfilled all requirements of other characteristics, performance characteristics should be avoided and be used only if a difference could not be found in other morphological characteristics, especially in those correlated to the performance characteristic in question.

Electronic Exchange of Data

19. Mr. Spellerberg (Germany) reported that he had only received replies to the request for the transmission of lists of fruit varieties under test, protected and/or withdrawn from New Zealand and from South Africa. The Working Party reconfirmed its interest and the need for such information in a combined form. With some reluctance on the part of some experts, it agreed that Mr. Spellerberg would await the UPOV CD-ROM prototype. If the CD-ROM containing the said information did not satisfy the need for information in the field of fruit varieties, he would ask the members of the Working Party for the information again, indicating the headings of the information requested, and would prepare an updated floppy disc for the next session of the Working Party. In view of the absence of Mr. Bar-Tel (Israel) who had proposed the collection of information on the grouping characteristics of strawberry varieties, the Working Party did not enter into discussions on that subject.

Testing of Disease Resistance

20. The Working Party noted document TWA/23/10 containing a summary of UPOV discussions on disease resistance in DUS testing. It also noted the following three main questions: (i) whether to use only cases of clear absence or presence; (ii) whether to use only clear resistance or also tolerance; and (iii) whether to include disease resistance characteristics in Test Guidelines but without an asterisk. During its visit it also heard a lecture on resistance research. A definition of resistance terms, presented during that lecture, is reproduced in Annex VI to this report.

21. The Working Party repeated that disease resistance in fruit species should, in principle, only be used as a last resort. However, the Working Party was aware of the fact that the situation was different for other groups of species, and that for vegetable species resistance characteristics were in many cases used as grouping characteristics. The decision whether to use resistance characteristics for distinctness would therefore depend very much on the species concerned and the genetic basis of resistance. For Japanese Pear, the Working Group accepted a resistance characteristic as it had actually been used to establish distinctness.

22. In many cases resistance was not a black and white situation, and different degrees of resistance existed. This fact was not a problem for the acceptance of the characteristic as long as there was a good description of

each state of expression. The Working Party made it clear that, with respect to vegetatively propagated varieties, the situation was completely different from that of seed propagated varieties. Different degrees of resistance should not be confused with lack of uniformity or different disease pressure. As each plant was a clone, the degree of resistance could be observed on each plant of the variety. Each plant would show the same degree of resistance. The Working Party therefore proposed to the Technical Committee that it approve, in the draft Test Guidelines for Japanese Pear, a resistance characteristic with states from "absent or very weak" to "very strong."

List of Species of which Practical Technical Knowledge has been acquired

23. The Working Party noted document TWO/27/13 initiated by the TWO but which now covered all species. It agreed that such a list was useful in the field of fruit varieties. Furthermore, it asked its members to supply the information necessary to update and complete the above document as soon as the UPOV Office circulated the request for updating. It proposed a routine updating of the list every second year.

Discussion on Working Papers on Test Guidelines

Test Guidelines for Citrus (Revision)

24. The Working Party noted documents TWF/23/6, TWF/24/3, and that the experts from South Africa had prepared a new proposal. During that preparation it had become obvious that it was very difficult to find example varieties for each state of expression of all characteristics. In South Africa no central reference collection existed. The relevant varieties have grown in different areas and it was difficult to compare results from different areas. The Working Party considered it more important to have a revised version of the Test Guidelines for Citrus, even without all example varieties, than to wait several more years until an example variety could be found for each case. Experts would communicate with one another in order to complete the document. Thus the next draft would concentrate on changes other than of example varieties.

Test Guidelines for Prunus Rootstocks

25. The Working Party noted documents TWF/24/4 and TWF/25/4. It had a general discussion on the establishment of Test Guidelines for rootstocks apart from Test Guidelines for fruit varieties and on the question whether or not to use characteristics of the flower or fruit of rootstock varieties. The Working Party reconfirmed that separate Test Guidelines for rootstocks were necessary for several species, especially in view of the frequent existence of interspecific hybrids in rootstocks and because of the particular importance of juvenile and disease resistance characteristics. Moreover, several rootstocks were sterile and it was not possible to observe flower or fruit characteristics. While Test Guidelines could focus on vegetative and physiological characteristics, fruit varieties had only a limited number of vegetative characteristics, insufficient to distinguish all rootstocks.

26. As a result of its dicussions, the Working Party agreed to prepare Test Guidelines for rootstock varieties without characteristics of the flower, the fruit or the seed. Should those characteristics be necessary for distinction, the closest appropriate Test Guidelines for fruit varieties should be used for the observations as long as it was possible and meaningful. In the case of

interspecific hybrids, both of the corresponding Test Guidelines for fruit varieties should be used.

27. Following the above decision, the Working Party deleted characteristics 38 to 107 and 109 to 112 in document TWF/25/4. Furthermore, it made the following main changes in that document:

(i) Subject of the Guidelines To apply to all rootstock varieties of the genus Prunus L.

(ii) Material required: The quantity of plant material to be submitted to be "(a) 25 rooted cuttings or (b) 100 seeds." To have also the standard wording on meristem culture added and a sentence stating that, if the variety could only be propagated by meristem culture, the applicant had to grow the plants one year in the field before submitting them to the competent authority.

(iii) Conduct of tests: Paragraph 1 to have the addition "after establishment." In paragraph 3 the number of plants to be 20 for vegetative propagation including meristem culture, 25 for seed propagated plants from controlled pollination and 50 for seed propagated plants from uncontrolled pollination.

(iv) Methods and observations: To have the standard paragraph on population standard (1%), acceptance probability (95%) and the number of off-types (1) admissible with the sample size (20). Paragraph 1 to apply to vegetatively propagated varieties only. For seed propagated varieties the experts will still request the national statisticians to advise them on the use of the COYD and COYU analysis, as that method had so far not been applied by the Working Party. Paragraph 2 to comprise the same different figures for the sample sizes as paragraph III (3). Thereafter a new paragraph to be inserted reading: "All observations on the one year old shoot should be made during the dormant season."

(iii) Table of Characteristics:

Characteristics

1 to 3 To have the word "Tree" replaced by "Plant"

3 To read: "Plant: attitude of branches" with the third state to read: "drooping"

7 To have the states "1, 9"

Time constraints did not permit discussion of the remaining characteristics.

Test Guidelines for Apple (Revision)

28. The Working Party noted document TWF/25/2, comprising the report of the Subgroup meeting held in Wye, United Kingdom, from December 13 to 15, 1993, and document TWF/25/3, comprising the new draft for fruit varieties of Apple resulting from that meeting. It finally made the following main changes in document TWF/25/3:

(i) Subject of these Guidelines: To apply to all vegetatively propagated fruit varieties of Malus Mill. The Test Guidelines have been prepared for hybrid varieties. In the case of mutants, the competent authorities should adjust the figures as necessary.

(ii) Methods required: Budwood to be sent in at budding time, and graftwood at grafting time. Trees to be sent in on M9 (MM 111 for spur types) (MM 106 for conditions which favor wolly aphid (Eriosoma lanigerum)). The competent authorities to select the most appropriate rootstock. To have in addition the standard phrase on the use of meristem culture included.

(iii) Methods of observation: Paragraph 2 to receive the addition "...in the case of use of M9 rootstocks. In the case of use of other rootstocks less trees may be sufficient." Paragraph 4 to have before the last word the following included "one year old vegetation." Paragraph 7 to have the words "an average of 10" deleted. Paragraph 9 to be deleted. Paragraph 10 to have the addition "for consumption."

(iv) Table of Characteristics:

Characteristics

2 To be split into the following two characteristics:

(a) "Tree: type" with the states "columnar (1), ramified (2)"
(b) "Tree: habit" with the states "fastigiate (1), upright (3), spreading (5), drooping (7), weeping (9)"

9 To have the word "relative" added before "position"

14 To have "indentation" replaced by "incisions"

15 To be recorded as for 11

18, 19 To be placed before characteristic 17 and to have the plus "(+)" deleted

17 To have the words "short" and "long" replaced by "broad" and "narrow"

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

22 To have the Notes "1, 2 , 3"

34 To be deleted

35 To have the bracketed addition "if visible"

39 To have "type" replaced by "pattern"

40 To have the additional example variety "Arlet (7)"

42 To have "Alkane" deleted

44 To have the example variety "MacIntosh (7)" added

46 To have a plus "(+)" added and the example variety "Worcester Pearmain" corrected

47 To have the example variety "Ein-Shemer" corrected

48 To have the example variety "Granny Smith (9)" added

(v) Explanations on the Table of Characteristics: To have the drawing for Ad. 17 and Ad. 25, etc., placed with the stalk to the top.

(vi) Technical Questionnaire: To have paragraph 5.1 deleted.

Test Guidelines for Cherry (Revision)

29. The Working Party noted documents TWF/24/2 and TWF/25/5 and made the following main changes in document TWF/25/5:

(i) Subject of these Guidelines: To have the common name placed each time after the Latin species name.

(ii) Material required: To have the word "rootstock" repeated after Prunus mahaleb in paragraph 1 and to have the name of that species repeated in the sentence following its first mentioning.

(iii) Methods and observations: To have a paragraph inserted indicating the population standard, the acceptance probability with the number of off-types tolerated. In paragraph 2 the minimum sample to be 10. Paragraph 3 to read: "All observations on the tree and the one year old shoot should be made during winter." Paragraph 4 to read: "All observations on the leaf should be made at the end of the growing season on the middle leaf of a spur."

(iv) Grouping of varieties: To have the use of the term characteristic(s) deleted and the groups to follow the same order as at the beginning of the document.

(v) Table of Characteristics:

Characteristics

1 To receive drawings to be prepared by experts from France

1, 12 To receive an asterisk

3 To have state 2 read: "semi-upright"

4 To read: "Tree: branching"

6 To read: "One year old shoot: position of vegetative bud in relation to shoot" with the last state "strongly held out"

10, 13 To have the states "small, medium, large"

17 To have the first state "round"

18 To be observed as characteristic 16

20 To have the bracketed addition "in frontal view" and state 4 read "oblong." The expert from France to amend the drawing indicating the suture.

21 To have an additional state included after "orange red" to read: "light red (Montmorency)"

22 To read: "Fruit: size of lenticels on skin"

23 To read: "Fruit: number of lenticels on skin"

24 To have the first state read: "colorless"

25 To have the additional example variety: "Bigarreau d'Or (2)"

26 To have the states: "soft, medium, firm"

27 To be split into two characteristics, both with the states "low, medium, high", the first on "acidity" and the second on "sweetness"

28 To have the states "low, medium, high"

29 To be placed after characteristic 20 and to have the first state read: "depressed"

31 To have the bracketed addition: "after harvesting"

33 To have the bracketed addition "in central view", the states to read: "narrow elliptic (1), broad elliptic (2), round (3)" and drawings to be prepared by experts from France

34 To read: "Stone: size in relation to fruit"

36 To read: "Time of fruit maturity"

The expert from Germany to check the spelling of several example varieties and to prepare a drawing explaining dorsal and ventral view.

(iv) Literature: The experts from France and Germany to reduce the number of cited publications.

Test Guidelines for Peach (Revision)

30. The Working Party noted document TWF/25/7 and made the following main changes in that document partly in a Subgroup meeting and reported orally to the full session and partly in a full evening session.

(i) Subject of these Guidelines: The Test Guidelines to apply to all vegetatively propagated varieties of peach and nectarine of the species Prunus persica (L.) Batsch.

(ii) Technical Notes: To have the same new layout of the Technical Notes as in other Test Guidelines. The plant material to be supplied to be 8 trees (one year old grafts) on peach rootstock (Montclair) or on almond x peach rootstook (GF 677). To have the corresponding sentence on compatibility as for Cherry and on meristem culture of the plant scion. The grouping characteristics to be 1, 10, 12, 32, 60 and 62. All observations on the flowering shoot and the flower should be made in the central third of the shoot unless otherwise stated; all observations on the flower should be made on fully opened flowers. In paragraph 11, the beginning of flowering is reached when 10% of the flowers on the tree are fully opened, the end when 90% of the petals fall. All observations on the necataries (glands) should be made on leaves as soon as they are fully developed. In general, paragraphs III, 1, 2, 3 and 4 of the Test Guidelines for cherry should be copied, paragraph 2 starting with "Unless otherwise stated, and paragraphs IV 1, 2, 3, 4 , 5 should be copied, paragraph 5 with a sample size of 6 trees. The observation on leaves to be made on 15 fully developed leaves from the central third of a current season shoot, the observation on the fruit should be made at the time of maturity when it is ready for eating. All observations on the stone should be made on the dry stone with the flesh removed.

(iii) Table of Characteristics:

Characteristics

1 To read: "Tree: size" with the states "small (Bonanza), medium, large (Redhaven)"

3 To have the states "upright, semi-upright, spreading, drooping, weeping"

4 to 9 To have the bracketed addition "excluding brindilles"

6 To have the bracketed addition "side away from sun"

10, 11 To be placed at the end after characteristic 61

12 To read: "Flower: type" with the states "not showy, showy" and "to be further studied"

13 To have the addition "on inner side" after "color"

14. To read: "Petal: shape" with the states "rounded, oblong"

18 To read: Stamens: position compared to petals (at the beginning of opening)" with the states "below (1), same level (2), above (3)"

20 To have the Notes "1, 2, 3"

23 To be placed at the end after characteristic 61

24 To be replaced by "Leaf blade: length" with the states "short, medium, long" and "Leaf blade: width " with the states "narrow, medium, broad"

26 To have the states "concave (1), flat (2), convex (3)"

27 To read: "Leaf blade: recurvature of apex" with the states "absent, present"

29 To read: "Leaf blade: angle at apex"

33 The experts from France to prepare new drawings and the second state to read: "reniform"

34 To have the first state read: "usually two"

35 To be placed after chracteristic 35 and to read: "Young shoot: length of stipule (fully expanded leaf)"

37 To be observed in "frontal" view with the states to read: "broad oblate, oblate, round, ovate, elliptic"

38 To read: "Fruit: shape of pistil end" with the states "depressed, flat, pointed"

39 To be observed as for 38

40 To read: "Fruit: prominence of suture" with the states "weak, medium, strong"

41, 42 To have the term "petiole" replaced by "stalk"

44 To read: "Fruit: extend of over color"

49 To have the states from "very soft" to "very firm"

50 To have the states "greenish white (1), white (2), cream white (3), light yellow (4), yellow (5), orange yellow (6), orange (7), red (8)"

54 To have the states "non-fibrous, fibrous"

55 To read: "Fruit: sweetness"

57 To be observed in profile view with the states "oblate, round, obovate, elliptic"

58 To have the states "light, medium, dark"

59 To be observed at peak harvest

61 To have the first state read: "weak"

62 To read: "tendency to preharvest drop"

63, 65 To be deleted

To have the proposals from page 2 included with the following changes:

33 The expert from France to prepare a new drawing

43 A new characteristic after the new characteristic 43 to be inserted reading: "Fruit: over-color" with the states "absent, present"

44 bis To read: "Fruit: color of over-color" and to have the following states: "orange-red (1), pink (2), pink-red (3), light-red (4), medium red (5), dark red (6)"

44 ter To read: "Fruit: pattern of over color" with the states "solid flush, mottled, striped, marbled"

55 bis To read: "Fruit acidity" with the states "low, medium, high"

Test Guidelines for Strawberry (Revision)

31. The Working Party noted document TWF/25/8 and made the following main changes in that document:

(i) Subject of these Guidelines: The Test Guidelines to apply to all vegetatively propagated varieties of *Fragaria* x *ananassa* Duch. and *Fragaria elatior* and their hybrids.

(ii) Technical Notes: This and the following paragraphs to follow the new presentation. The standard phrase on meristem culture to be added. The grouping to be made according to characteristic 45. Fresh summer plants to be used -- no waiting bed, no cold store. Unless otherwise stated, all observations on the flower should exclude the primary flower. Unless otherwise stated, all observations on the fruit should be made on secondary fruits of one year old plants at harvest maturity.

(iii) Table of Characteristics:

Characteristics

1 To keep "Gorella"

3 To keep "Grande"

4 To have "green" deleted from the characteristic and to have the states "yellow green (Tristan), light green, medium green, dark green, blue green (Myrak)"

5 To have the words "shape in" inserted

6 After this characteristic a new characteristic to be inserted reading: "Leaf: glossiness" with the states "weak (Myrak, Aptos), medium (Irvine), strong (Tioga)"

8 To have no drawings and to keep the Notes "3, 5, 7"

10 To read: "Terminal leaflet: shape of incisions of margin" with the states "serrate, dentate, crenate"

15 To be deleted

16 To be kept

19 To keep "Grande"

20 To read: "Primary flower: relative position of margins of petals (...)"

22 To have no drawings; after this characteristic a new one to be inserted reading: "Plant: number of fruits" with the states "few (Pajero), medium (Chandler), many (Elsanter)"

24 To have the word "maximum" deleted

25 To have "Precosa" kept and "Polka" deleted

26 To be kept in the typed version without the proposed changes and to have the last two states read: "ovate, reniform"

27, 29 To be kept

30 To have the last two states read: "dark red, red black" and the additional example variety "Honey Oya"

34 To read: "Fruit: shape of stalk end" with the states "concave, flat, convex"

35 To have the states "clasping (1), spreading (2), reflexed (3)"

37, 38 To be kept

39 After this characteristic a new characteristic to be inserted reading: "Fruit: distribution of read color" with the states "only marginal, only central, marginal and central"

40 To be deleted

45 To have an additional state "day neutral"

(iv) Literature: To have the fourth citation deleted.

(v) Technical Questionnaire: To include in paragraph 4 the request for information on meristem culture as for Japanese Pear, and in paragraph 7 the statement that, in case special requirements were needed for the growing of the variety, the applicant should contact the competent authority.

Status of Test Guidelines

32. The Working Party agreed that the draft Test Guidelines for Japanese Pear (Revision) should be sent to the Technical Committee for final adoption. It agreed that the draft Test Guidelines for Apple (Revision), Cherry (Revision), Peach (Revision) and Strawberry (Revision) should be sent to the professional organizations for comments. It agreed to rediscuss the Test Guidelines for the other species mentioned in the agenda at its next session.

Future Program, Date and Place of Next Session

33. At the invitation of the expert from the United Kingdom the Working Party agreed to hold its twenty-sixth session in Wye College, Canterbury, with visits to Faversham and Cambridge, United Kingdom, from September 11 to 15, 1995. During the session, the Working Party planned to discuss the following items:

(a) Short reports on new developments in member States in plant variety protection for fruit species (oral reports)

(b) Important decisions taken during the previous sessions of the Working Party, the Technical Committee and the Technical Working Party on Automation and Computer Programs (oral reports)

(c) Color observations (report from the United Kingdom)

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

(e) Bibliography of published papers on new techniques (GB to receive information in addition to document TWF/24/8 by the end of June 1995)

(f) Statistical methods

(g) Uniformity in vegetatively propagated and self-pollinated varieties

(h) UPOV Central Computerized Data Base

(i) Characteristics on disease resistance

(j) List of species of which practical technical knowledge has been acquired

(k) Final discussions on draft Test Guidelines for:

- Apple (Revision)
- Cherry (Revision)
- Peach (Revision) and
- Strawberry (Revision)

(1) Discussions on working papers on Test Guidelines for:

- Citrus (Revision), TWF/23/6, TWF/24/3, (ZA to prepare a new working paper)
- Prunus Rootstocks, TWF/24/4, TWF/25/4, (FR to collect information by the end of 1994)
- European Plum (Revision), TG/41/4, TWF/25/6, (FR to collect information by March 1995)
- Japanese Apricot (Prunus mume), TWF/25/10, (JP to collect information by March 1995)
- Loquat (Eriobotrya japonica) (JP to prepare a working paper by March 1995)
- Pear (DE to prepare a working paper by March 1995)
- Pear Rootstocks, TWF/25/11, (DE to collect information by March 1995)
- Walnut (FR to prepare a working paper by December 1994)
- Walnut Rootstocks (FR to prepare a working paper by March 1995)
- Kiwifruit (NZ to prepare a working paper by June 1995)
- Grape (FR, IT to prepare a working paper by March 1995)
- Apple Rootstocks (GB to prepare a working paper by March 1995)

Visits

34. During a lunch offered by the Fruit Industry Plant Improvement Agency New Zealand Limited (FIPIA NZ Ltd.) on September 19, 1994, the Working Party received information on its work, especially in the field of identification and introduction of fruit varieties, which may have potential for the national fruit industry, on its activity as an agent for the owners of new varieties, and on its budwood selection scheme.

35. In the afternoon of September 20 the Working Party visited the Hort Research, at Havelock North, where it obtained background information on the PVR testing of fruit varieties in New Zealand and an introduction to the orchard, followed by a walk through the orchard. It further received an introduction to Hort Research, to the testing of and breeding for disease resistance, on the fingerprinting of apples, on color measurement and on the breeding of apples in general.

36. In the afternoon of September 21, the Working Party travelled by bus to Rotorua via Lake Taupo.

37. On September 23, it travelled to the Bay of Plenty area to visit the Te Puke Research Centre specializing in research into and the breeding of kiwifruit, citrus and subtropical fruit. After an introduction to the Te Puke and Kerikeri Research Centres, it received information on the PVR testing of fruit, on kiwifruit breeding, on the gene bank and on citrus breeding, followed by a walk through the orchard. Furthermore, it visited a commercially run property producing kiwifruit, avocado and out-door cut flowers, and a specialist of New Zealand native plant nurseries, the Omahanui Nurseries.

38. On September 24, it left Rotorua by bus visiting the Waimangu Thermal Area and, near Hamilton, the Ruakura Research Centre dealing with the researching and breeding of blueberry. The visits concluded with an excursion to the Auckland Regional Gardens with plants suitable for the Auckland region, where it received an introduction to the breeding of Hebe and Leptospermum.

39. In the afternoon of September 25, those experts travelling to Australia for the session of the Technical Working Party for Ornamental Plants and Forest Trees departed from Auckland Airport to Sydney.

40. This report has been adopted by correspondence.

[Six annexes follow]

ANNEX I

LIST OF PARTICIPANTS AT THE TWENTY-FIFTH SESSION OF THE TECHNICAL WORKING PARTY FOR FRUIT CROPS, NAPIER AND ROTORUA, NEW ZEALAND, SEPTEMBER 19 TO 24, 1994

I. MEMBER STATES

FRANCE

Raymond SAUNIER, Station de Recherches fruitières, INRA - C.R. Bordeaux, Domaine de la Grande Ferrade, B.P. 81, 33883 Villenave d'Ornon Cedex (tel. 56 84 30 81, fax 56 84 30 83)

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NEW ZEALAND

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SOUTH AFRICA

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Peter DODD, Wye College, University of London, Wye, Ashford, Kent (tel. 0233-812-400, fax 0233-813-017, E mail: P.Dood@wye.lon.ac.uk)

II. TECHNICAL EXPERTS

NEW ZEALAND

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M. MALONE, Hort Research, Private Bag 1401, Havelock North, (tel. 06-8778 196, fax 06-877 4761, E mail: M.Malone@ hort.ac.nz)

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III. OFFICER

Elise BUITENDAG (Mrs.), Chairman

IV. OFFICE OF UPOV

Max-Heinrich THIELE-WITTIG, Senior Counsellor, 34, chemin des Colombettes, 1211 Geneva 20, Switzerland (tel. 022 7309152, telex 412 912 ompi ch, fax (041-22) 7335428)

[Annex II follows]

600

TWF/25/12

ANNEX II

MINISTERE DE L'AGRICULTURE ET DE LA FORET
MINISTERE DE LA RECHERCHE ET DE LA TECHNOLOGIE
INSTITUT NATIONAL DE LA RECHERCHE AGRONOMIQUE
CENTRE DE RECHERCHES DE BORDEAUX

INRA

STATION DE RECHERCHES FRUITIERES

V/Réf. :

N/Réf. : RS SB

Objet :

Villenave d'Ornon, le 13 septembre 1994

In France, fruit species protection through certification involves all fruit species, and particularly a large number of Peach and Apple cultivars. (The certificates issued are called COV, i.e. Certification d'Obtention Végétale).

Today, the numbers of COV issued or applied for are distributed as follows :

	COV issued, accepted	COV applied for
APRICOT	9	23
ALMOND	1	2
BLACKCURRENT	2	-
CHERRY	11 (including 9 R.S.)	20
QUINCE	1	-
RAPSBERRY	4	-
HAZELNUT	1	-
PEACH	59 (including 3 R.S.)	113
PEAR	11 (including 8 R.S.)	20
APPLE	44 (including 4 R.S.)	83
PLUM	13 (including 11 R.S.)	3
BLACKBERRY	2	-
GRAPEVINE	24	2
R.S. : Rootstock	182	260

INRA. Centre de Recherches de Bordeaux
71, avenue Edouard-Bourleaux

There are many difficulties in identifying apples among which 2/3 of new varieties are mutants of varying stability. In the peach, identification problems are linked with the high number of new varieties and their rapid turnover. Consequently, at present, ¼ to 1/3 of peach COV applications are withdrawn by the time the certificate is ready to be issued.

Other difficulties are due to numerous rootstocks, issued from interspecific hybrids which are often sterile and therefore difficult to describe as they have fewer morphological characters (absence of flower, fruit and stone). For this reason, the study of biochemical and molecular markers in order to characterize new fruit material, and in particular mutants, appears essential. The INRA stations at Angers and Bordeaux have invested important means to try and answer the need for characterization of varietal identity.

In the apple, work carried out so far at INRA have allowed the use of biochemical markers to characterize genetic variability within the *Malus* and *Pyrus* genus. Although isoenzyme markers can reveal sufficient polymorphism to listinguish between unrelated apple varieties, the technique has not enabled u to distinguish mutants.

The studies developped on RFLP and RAPD markers have proved insufficient for distinguishing mutants. A higher number of markers would be necessary. The RAPD technique may be the most promising, providing a large number of restriction enzyme primers are used.

This approach is envisaged at INRA for rapid identification of *Prunus* species and in particular of peach varieties which have a very high turnover. Bidimensional electrophoresis of protein or phenolic markers is also envisaged for characterizing *Prunus* varieties.

In *Prunus* species, the identification of sterile interspecific hybrids with no flower, fruit or stone morphological descriptors would also be greatly facilitated (by this approach).

Concerning genetic resources, the *Prunus* European database management was tranfered to Bordeaux in 1993. In order to pursue an active proteciton of existing resources, while maintaining satisfactory health standards, investment has been made at INRA, BRG and the National Botanical Conservatory at Porquerolles.

[Annex III follows]

PROCEDURE FOR THE EVALUATION OF A MUTATION/SPORT VARIETY TO ASSESS UNIFORMITY AND STABILITY.

Purpose

The purpose of the assessment is to detect evidence of mutation or other genetic instability. Such a problem might be expected to manifest itself in one of two ways:

- A part of a tree producing fruit with skin colouration or patterning outside the expected range for the candidate variety, eg block colouring instead of striping, reversion to parent variety colouring.
- A tree producing fruit with chimeral striping.

The assessment is not to measure the variation normally found within a variety such as that caused by the position of fruit on the tree.

Trees assessed

The applicant is to make available for assessment 25-30 second-generation trees in their second year of fruiting or later. No more than 20% of the trees (eg 5 out of 25, or 6 out of 30) should come from any single stick of budwood.

A true assessment requires that a minimum of 25 trees should each produce at least 40 fruit. If the number is less the assessment should be postponed until the following harvest.

Procedure

The assessment is to be carried out at the normal harvest time.

Inspect each tree before fruit is picked checking for a part of the tree that may be carrying a number of fruit with skin colouration or patterning clearly different from the norm for the variety. Such a tree part should be described and photographed. The tree should be recorded as an off-type and left unharvested in case the expert should wish to inspect it.

With each remaining individual tree (ie excluding any that may have been already recorded as an off-type), harvest and put all fruit in a separate container. Then:

- Inspect the fruit in each container looking for signs of genetic instability, in particular chimeral striping.
- Compare the fruit in each container against that in all others. This is to check whether any one tree shows divergence from the variety norm.

If off-type fruit are detected in a container count the number. The tree should be recorded as an off-type if a third or greater of the fruit in the container are off-types. For a sample size of 40 fruit, a minimum of 13 off-type fruit would lead to the tree being recorded as an off-type.

If problems are detected record a description of the nature of the problem and the numbers involved. Hold samples for possible inspection by the expert.

With 25 trees the maximum number of off-type trees is 2. The table below gives the off-types permitted with sample sizes greater than 25. (It is based upon an acceptance probability of 99% and population standard 1% - these bases obtained from UPOV document TWC/11/16 - recommendations on homogeneity.)

Trees sampled	Maximum off-types
16-44	2
45-83	3
84-129	4
130-180	5

[Annex IV follows]

ANNEX IV

DIGITAL PHOTODATABASE FROM CPRO-DLO, WAGENINGEN, THE NETHERLANDS.

Purpose: A simple and easy system for the storage of pictures of varieties under test and reference varieties.

Main characteristics:
- easy to use for all workers of DUS trials
- a large capacity
- a rapid search system with keywords
- prints can be produced
- relatively unexpensive
- safe data-storage (central storage, automatic Back-up)
- the image is compressed

Equipment:
- a video camera (we have a professional type: JVC KY-F30CI 3-CCD, but a good quality non-professional camera e.g. Hi-8 or S-VHS will do also and is less expensive)
- a video printer: SONY UP 1800 EPM
- a monitor for ajustment of the camera/printer
- a PC that can handle images: e.g. Apple 660 AV quadro with extended internal memory (10 Mb)
- Software e.g. Aldus 'Fetch' 1.2
- Photo equipment: lamps, stand, sample holder, background
- (- in our case we have chosen to store the images in a mainframe with automatic back-up)

Costs: the complete system with a non-professional camera have costed us less than f 20.000,-- (appr. $ 13,000). One print costs ca. f 1,90 ($ 1.20).

Objects: from 1 cm up. Also pictures can be scanned and images from video can be stored.

Database: each user or group of users has its own database/databases. We choose for a separate database for each crop. The images are stored on a mainframe and connected with the database. In the database itself the next data are stored:
- the name of the image (filename)
- data of the image e.g. place of storage, size, type
- a post-stamp picture of the image
- keywords
- (- a description of the object)

Due to keywords and the name of the image it is possible to select images easily.

Images: ca. 70 K / 72 dpi

[kwa]video.wp5

[Annex V follows]

TWF/25/12

ANNEX V

The Measurement of Red Colour of Apple Fruit Using Digital Imaging

Allan G. White
Division of Horticulture and Processing
DSIR, Havelock North.

Phillip M. Ngan
Department of Computer Science
Massey University.

Introduction

The objective measurement of red colour in apple fruit is important in the study of the physiological and genetical mechanisms relating to red colour expression. Traditionally red colour has been measured by the human eye against sets of standard colour cards or chips. This method is still important and appropriate in many situations where the measurements required are related to consumer preferences or field harvest maturity indices, for example colour chips are currently used to establish harvest maturities for apples, nashi and persimmon in New Zealand. They are however not sensitive or consistent enough in evaluations where continuous change or additive effects are to be measured. This is illustrated by the results of a panel of ten experienced observers who were asked to estimate the red content and stripe content, against a set of standards, of the same fruits used in the other data presented in this paper (Table 1).

	%Dark Red Range	%Medium Red Range	%Orange Red Range	%Stripe Range
Gala	0-15	1-55	20-80	25-95
Royal Gala	20-80	10-60	0-20	40-95
Regal Gala	40-90	10-25	0-10	0-5

Table 1 : Range in estimation of the amount of Red Colour and Stripe on the apple cultivar Gala and two of its mutations by a panel of ten experienced observers. DSIR Research Orchard, Havelock North.

The use tristimulus colour analysis [1] to measure reflected colour has become important and widespread in fruit research because these apparatus do offer an objective measure of colour [2]. Their use is however, effectively limited to the assessment of block or uniformly coloured fruits as their readings are the sum of the total pigment content (chromaticity) of the fruit skin. Sampling rotating

fruit to give an average reading over the surface area has been used [3]. With multicolored or striped fruit this reading is of limited use as the areas covered by the different colour patterns are generally more important.

The surface coloration of apple fruit exists in three common patterns: a uniform wash over the entire surface of the fruit, blocks of colour, and vertical stripes. Since these patterns are directly related to the genetic composition of the fruit their quantification is useful in the genetic characterisation of the fruit and the response of fruit pigmentation to physiological parameters.

By digitising the image of an apple or the surface area sampled it is then possible to analyze the image quantitatively as well as qualitatively for colour.

The Colour Measurement Method

The image processing algorithm for measuring surface coloration on apple fruit is performed in three stages: (i) the acquisition of an image that closely depicts the coloration of the fruit over its entire surface, (ii) the red content measurement, and (iii) the stripe content measurement. The purpose of this section is to describe the design and implementation of image processing methods used in making these measurements.

Computer Equipment

The measurement algorithm described in this section was developed to work with the Imaging Technology PCVISIONplus Frame Grabber and ITEX software library. The PCVISION*plus* system is a PC card that interfaces with the standard XT or AT bus. This card includes two 512 x 512 x 8-bit pixel frame buffers and facilities for frame grabbing and image display. Companion to the PCVISION hardware is the ITEX PC library, an object code software library that provides a comprehensive suite of functions for controlling all aspects of the frame grabber operations including: acquiring images, reading and writing image data to disk, and reading and writing image data to and from the host computer RAM. Central to the image processing system along with the PCVISION frame grabber and ITEX software is the general purpose PC computer. This PC host performs vital operations like the numeric computation of the image data as well as storing and retrieving image data to and from disk. All software described in the following sections was written in Microsoft C. Acquiring the Mosaic Image.

Acquiring the Mosaic Image

The key feature of the colour measurement algorithm described in this paper is the ability to acquire an image that depicts the coloration over the entire surface of the fruit. Such an image could be acquired by peeling the skin off the fruit so that it is in one piece, then flattening it and lastly taking a snapshot of it with a video camera - this could be called the *peeled image*. Acquiring peeled images for all but a few samples poses severe practical limitations in effort and speed. In practice, an approximation to the peeled image can be acquired by placing the fruit on a turn-table so that it rotates about its longitudinal axis, then taking a series of snapshots of the side-view of the fruit as it rotates. 256 snapshots are taken for one fruit revolution in the final software implementation. A near replica of the peeled image can be constructed by extracting a column of pixels from each snapped image and stacking them side-by-side to build up a *mosaic* of the fruit surface. The position within the snapped image that the sample is taken from coincides with the axis of turntable rotation.

The *mosaic image* can only be considered approximate rather than an exact replica of the peeled image because the sampling method for constructing the mosaic image assumes that the fruit has straight sides. In reality, apples are shaped more like a sphere than like a tin-can. The sampling scheme copes with real fruit by excluding from the column samples, the regions in the snapped image where the fruit is not present, or where the fruit surface is clearly curving away from the camera. Errors can be reduced by selecting uniformly shaped fruit. The top and bottom bounds of the sampling column is set by the operator (interactively using a mouse) as the first step in acquiring the mosaic image.

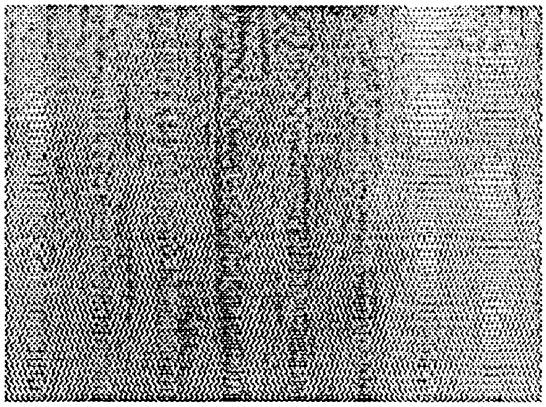

Figure 1 (i) : Mosaic Image of a Striped Fruit (Gala)

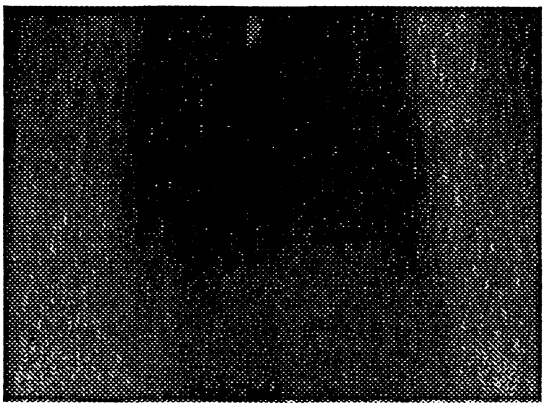

Figure 1 (ii) : Mosaic Image of a Block-Red Fruit (Royal Gala)

The variable vertical size of the sampling column gives rise to a variable number of rows in the mosaic image. However the number of columns will always be fixed at 256. The absolute size of the mosaic image does not affect the Red and Stripe measurements because both are relative area measurements. Figure 1 (i) and (ii) shows mosaics for striped and a block-red fruit.

Measuring Red Content

Determining the Red content in the mosaic image involves counting the number *red* pixels in the mosaic image and returning this count as a percentage of the total mosaic area. The first step in this task is to assume that the *redness* of a pixel is simply inversely proportional to its brightness value. Under this scheme if two different fruit are imaged under identical lighting conditions, then the fruit perceived as darker would be considered redder than one perceived lighter. This inverse relationship of redness to perceived brightness is illustrated by some real examples in figure 2(i and ii).

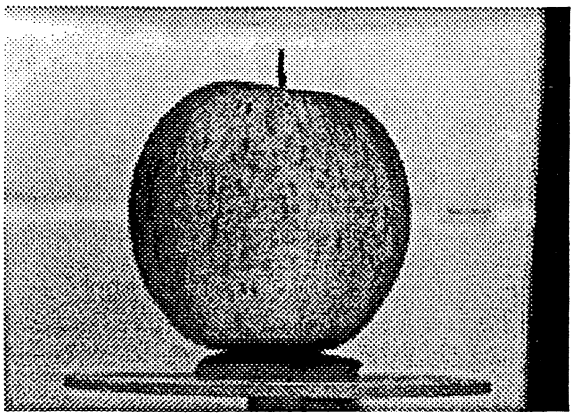

Figure 2 (i) : Gala has a light red colour.

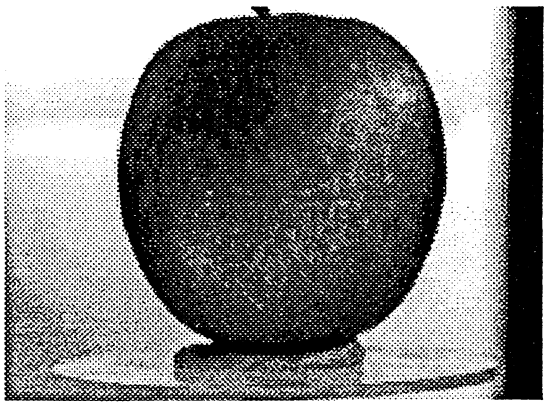

Figure 2 (ii) : Regal Gala has a darker red colour.

Not only must the imaging system be able to identify shades of redness, it must also distinguish non-red colours, such as greens and yellows which may be found in, say, immature fruit or in the Golden Delicious cultivar. Green and yellow fruit are readily distinguishable from red fruit because they are nearly always perceived to be brighter as shown in figure 2 (iii). The Red measurement algorithm need only go so far as to distinguish non-red from red coloration because the character of non-red coloration is not an issue under study.

The colour measurement algorithm classifies pixels in the mosaic into one of four intensity bands, hence colours. Ordered from light to dark pixel intensity, the four colours are: non-red, orange-red, medium-red and dark-red. The classification of the mosaic pixels is carried out by first calculating the

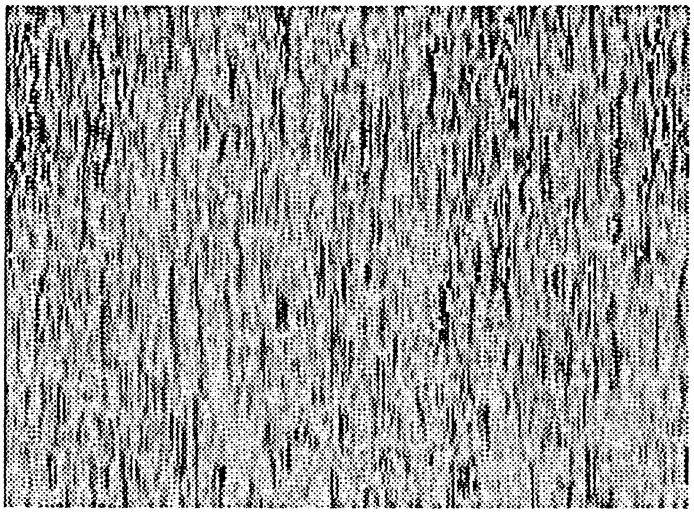

Figure 3 : The edge enhanced image of the Gala Mosaic.

Evaluation of the System

The system was evaluated by sampling one fruit each of the apple cultivar Gala and two of its colour mutations 50 times. The three forms of Gala were Standard Gala, a striped red fruit; Royal Gala, a heavily striped red fruit and Regal Gala, a solid block red fruit.

Measurements were made using a *Burle TC600X CCD* video camera linked to a PCVISION*plus* Frame Grabber board installed in a Bondwell T38 computer. The fruit was positioned on a purpose built turntable and rotated at 1 revolution per 21 seconds (equal to the time taken to acquire the image mosaic). Lighting was diffuse from florescent lighting in the laboratory with reflectors and screens used to provide a constant reading of 6.5 on an Asahi Pentax Spotmeter scale over the area being sampled. This level of lighting is quite low to minimise reflection from the surface of the fruit.

Colour Category	Threshold
Dark Red	93
Medium Red	129
Light Red	178
Stripe	255

Table 2 : Threshold settings

Calibration of the red colour characteristics was done directly using block coloured apples considered to be typical of each category. The stripe threshold was set at the maximum reflectance reading (Table 2).

Results and Discussion

Red/no red colour measurements displayed very little variation due to the sampling in the four colour grades (Table 3), with standard deviations in each category amounting to less than 1% of the total area sampled. Standard errors for a sample of 50 fruit were in all categories less than 0.2% and most categories less than 0.1%. The level of error arising from the sampling is well within that required by the usages for which the system was developed.

There appears no difficultly in setting the thresholds to conform the categories used in evaluation by subjective evaluation.

Errors can result from surface blemishes or deformities as these may cause shadows which appear as areas of low reflectance.

Stripe measurements also displayed very little variation due to sampling (Table 3). Definition of the area covered by stripe differs between the system and subjective evaluation. The system measures the area covered by the red stripe where as the human observer estimates the area in which striping occurs. Both measurements are important and further study is required to see if there is a relationship between the two.

The level of striping for the heavily striped Royal Gala was recorded as being less than for the more lightly striped Gala strain. This is because with Royal Gala the striping had coalesced in the more strongly pigmented areas leaving no vertical edges to be detected thus these were not distinguished from block colour.

Colour differences due to lenticels contributed to the stripe content. This showed up particularly in the block red Regal Gala which although it is not a striped apple recorded about 16% of the surface as striped. Further development of this aspect of the programme is required to enable us to distinguish lenticels from stripes.

Conclusions

Digital imaging provides a tool for the accurate measurement of red and non-red colour intensity and patterns of the surface of apple fruits. The measurement of striping is not so straight forward however and requires further development. Problems also exist in the distinguishing between solid blocks of colour due to heavy striping where the red stripes have coalesced and block coloration.

	Dark Red	Medium Red	Orange Red	No Red	Stripe
Gala Mean	2.34	16.87	45.55	35.23	38.63
Std.Dev.	0.19	0.90	0.72	1.20	0.40
Std.Err.	0.03	0.13	0.10	0.17	0.06
Royal Mean	81.93	10.89	6.01	1.17	25.89
Royal Std.Dev.	0.98	0.49	0.46	0.15	0.75
Std.Err.	0.14	0.07	0.07	0.02	0.10
Regal Mean	65.90	15.90	13.91	4.31	16.43
Regal Std.Dev.	0.77	0.44	0.36	0.22	0.38
Std.Err.	0.11	0.06	0.05	0.03	0.05

Table 3 : Variation in sampling of Gala and two of its colour mutations for Red Colour and Stripe.

References

[1] Francis, F.J. (1980): Color Evaluation of Horticultural Crops, *HortScience*, **15**(1), 1980, 14-15.

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[Annex VI follows]

ANNEX VI

PLANT

Resistance The combination of characteristics (morphological, biochemical, anatomical, physiological) which make that it is hardly or not attacked by a pest or disease.

General resistance The main effect resistance that is effective against all genotypes of the pathogen.
(horizontal, polygenic, quantitative)

Specific resistance The differential resistance that is effective against certain genotypes of the pathogen.
(vertical, monogenic, qualitative)

Susceptibility The combination of characteristics (morphological, biochemical, anatomical, physiological) which make that it is attacked by a pest or disease.

Tolerance The ability to withstand infection by a pathogen without showing distinct symptoms.

PATHOGEN

Pathogenicity The ability to infect plants

Agressiveness The main effect pathogenicity that is effective on a whole range of hosts.
(quantitative)

Virulence The differential pathogenicity that is effective on certain genotypes of the host.
(qualitative)

Main effect between host varieties	Horizontal resistance
Main effect between pathogen isolates	Agressiveness
Interaction varieties x isolates	Vertical resistance and virulence

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In: Vanderplank, 1984.

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