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COMMITTEE FOR TRADE, INDUSTRY AND
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Working Party on Standardization of
Perishable Produce and Quality Development

Specialized Section on Standardization of
Seed Potatoes

12 - 14 March 2001, Geneva

REPORT ON ITS THIRTY FIRST SESSION

Summary

Reservations concerning Annex IV were withdrawn or clarified.

The principle of the subdivision of categories was agreed.

Provisions for pre-basic TC were agreed.

The annex on sampling was agreed.

For the future work it was decided to:

- rewrite the introduction of the standard to better reflect its purpose and scope;
- investigate further the problem of superficial necrosis and the mop top virus;
- compile the results of the questionnaire;
- begin work on the standardization of methods;
- prepare a comparison between the UN/ECE and other standards;
- create an ad-hoc group which would deal with issues related to GMOs;
- hold an exchange on quality assurance;
- create an ad-hoc group which would propose destination tolerances to control tuber rots;
- prepare a proposal for the inclusion of visual aids in the standard;
- establish working relationships with WTO, IPPC, EPPO and NAPPO.

It was decided to restructure the work schedule of the group as follows:

- one 3-day meeting of the Specialized Section in early spring each year;
- assignment of tasks to individual rapporteurs or ad-hoc groups who will meet as necessary;
- one meeting of the bureau (with interested other parties) in autumn each year to prepare the session of the Specialized Section

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Opening of the session

1. The session was held in Geneva from 12 to 14 March 2001. It was chaired by Mr. Pier Giacomo Bianchi (Italy).
2. The group held a minutes silence in the memory of Mr. Uri Kimmel (Israel) the group's Vice-Chairman, who had died the year before. The Chairman recalled his long years of contribution to the work of the group and said that he will be missed.
3. The session was opened by the Deputy Director of the UN/ECE Trade Division, Mr. Hans Hansell, who welcomed the delegations to Geneva. He congratulated the group on their work in the last year and the successful meeting of rapporteurs held in Moscow.
4. He said that letters from the Russian Mission and the Russian State Seed Inspection showed that the meeting was very much appreciated. He thanked the Russian authorities for the excellent organization of the meeting and thanked especially Mr. Dimitry Dorokhov and Ms. Irina Solovieva in Moscow as well as Mr. Felix Grishaev from the Russian Mission in Geneva for their support. He said that he highly appreciated that the agenda contained items concerning the strategic position of this work. He concluded by wishing the delegations success in their deliberations and a pleasant time in Geneva.

Participation

5. The session was attended by delegations from the following countries: Canada, France, Germany, Greece, Ireland, Italy, Netherlands, Poland, Russian Federation, Switzerland, United Kingdom of Great Britain and Northern Ireland, and United States of America.
6. The European Community was also represented.

Item 1: Adoption of the agenda

Document: TRADE/WP.7/GE.6/2001/1

7. The provisional agenda was adopted with the following additions and changes:
 - TRADE/WP.7/GE.6/2001/4: Deletion of the square brackets
 - TRADE/WP.7/GE.6/2001/INF.1: Comments from Portugal were added under 4(b)
 - TRADE/WP.7/GE.6/2000/INF.7: Proposal from the United Kingdom under 4(c)
 - TRADE/WP.7/GE.6/2001/INF.3: Proposal from France and the Netherlands under 5
 - TRADE/WP.7/GE.6/2001/INF.2: Document from the Netherlands under 9.

Item 2: Matters of interest arising since the thirtieth session

Document: TRADE/WP.7/GE.6/2001/2

8. The delegations took note of this document which sums up the relevant outcome of the fourth session of the Committee for Trade, Industry and Enterprise Development and the fifty-sixth session of the Working Party on Standardization of Perishable Produce and Quality Development.

Item 3: Report of the Meeting of Rapporteurs on Standardization of Seed Potatoes

Document for this session: TRADE/WP.7/GE.6/2001/3

9. The group took note of the report of the meeting of rapporteurs which took place in Moscow from 24 to 27 October 2000. The Chairman said that at the meeting the questionnaire had been finalized and it had been very interesting to learn first hand about the situation in Russia.

10. A correction concerning paragraph 17 was noted: It should read "United Kingdom" instead of "Netherlands".

11. The delegation of Russia thanked the rapporteurs for the Recommendations given at the meeting and reported that the reactions in Russia had been positive as shown by the letter from the State Seed Inspection which recommended the adoption of the standard.

Item 4: Review of the UN/ECE Standard for Seed Potatoes

Document for this session: TRADE/WP.7/2000/11/Add.20 (Text of the standard in force)

12. The Chairman asked delegations about the status of the reservations contained in the standard . Concerning annex IV, Germany and Poland withdrew a reservation and Greece clarified a reservation. (see the Annex to this report).

13. The delegation of France noted that they had not entered a reservation but were in favour of a stricter standard. Their national standard prescribes a 0.2% tolerance.

Item 4(a): Review of Part II, Subpart E

14. This subject was already discussed extensively in the Meeting of Rapporteurs in Milan (1999) and the last session of the Specialized Section. The text provisionally adopted at the last session was not included in the standard because there was no consensus on this question. The secretariat reported that the legal counsel had been asked concerning the questions raised but that no reply had been received up to now.

15. Several delegations regretted that it had not been possible to receive a reply to the legal question after one year and also regretted that there was no delegation from the World Trade Organization (WTO), the International Plant Protection Convention (IPPC), the European Plant Protection Organization (EPPO) or the North American Plant Protection Organization (NAPPO) present who might have given important information on this subject.

16. The delegation of Canada who had proposed the text at the last session (see TRADE/WP.7/GE.6/2000/8, para. 13) regretted that it had not been adopted. They said that it had been an attempt to clarify the existing text. By mentioning the WTO-SPS agreement the present legislation had been taken into account and users would know that even if they were allowed to impose stricter measures they had to do so under the rules of WTO-SPS. It was also said that it was appropriate to add a link to WTO in the standard. This was supported by some delegations.

17. Other delegations felt that by mentioning non-quarantine pests in this paragraph, the regulation of these pests would be left to the individual countries and the standard would lose importance.

18. Others felt that even without dealing with these pests the standard had a lot to offer. It was mentioned that it was the only standard defining product quality, a certification scheme and varietal aspects.

19. The delegation of Switzerland said that to facilitate trade all necessary provisions should be included on one certificate. All necessary requirements for international trade for all regions should be included in one document together with the competent authorities in each country.

20. The secretariat suggested the following approach: As the standard (like all UN/ECE Standards for perishable produce) was a voluntary standard, a paragraph as had been proposed by Canada or even the existing paragraph was not essential and could be deleted at this place. He said that it was at the discretion of the group to define what they wanted to regulate and what not. The goal should be the definition of a good seed potato.

21. He suggested to rewrite the introduction to the standard concentrating on the goals of the standard.

22. This suggestion was welcomed by several delegations. After some discussion it was decided to proceed as follows:

- a framework for new introduction to the standard will be drafted by the secretariat explaining:
 - what are the goals of the standard (defining a harmonized trading language, defining product quality, a certification scheme and tolerances for certain quality pests),
 - what is not covered by the standard (quarantine, plant health aspects as long as they are not necessary for the certification scheme etc.)
 - who is covering those aspects not included in the standard;
 - what advantages a country will have by using the standard;
 - a phrase should be included about the meaning of a country applying the standard;
- the secretariat will meet with some delegations to refine the proposal and present it at the next meeting of rapporteurs;
- the draft document will be continuously available on the Internet for comments of delegations;

23. It was also mentioned that a list of varieties could be included in the standard based on the principle that a variety would figure if it is approved in at least one participating country.

Item 4 (b): Introduction of sub-divisions in the categories

Document for this session: TRADE/WP.7/GE.6/2001/4

24. This question was discussed at the last session with the goal of introducing more flexibility into the standard. At the meeting of rapporteurs in Moscow it was mentioned that a harmonized subdivision of categories could lead to more transparency in the market. In the document Canada and the United Kingdom present their proposal for the introduction of subdivisions.

25. The delegation of Canada introduced the proposal and said that they had tried to include more choice for buyers and sellers and also taken account of existing systems of sub-divisions. They had also proposed the inclusion of a field generation marker which could make it easier to establish an equivalence between different systems used and to achieve more transparency in trade.

26. The delegation of the United States said that the proposed system was confusing. It should be kept as simple as possible. He said that the only categories to be distinguished were clonal selection and micro propagation and that the only clear system of classification was a field generation system. He explained that

with the system used in the United States it had been possible to control blackleg. He reserved his position on the subdivision of categories as proposed.

27. It was mentioned by other delegations that even the system used in the United States was not a pure field generation system because depending on the tolerances a seed lot could be classified into a different generation than their physical age.

28. After some discussion it was decided to agree the principle of the subdivisions and that Canada and the United Kingdom would prepare a revised document for the Rapporteurs taking into account the comments made:

- S The names for the classes should be as follows:
 - Pre-Basic TC, Pre-Basic
 - Basic 1, Basic 2
 - Certified 1, Certified 2.
- S The tolerances should be well defined to differentiate between different classes within the same category
- S A field generation marker should be included as the physical age was an important information for the customer concerning seed vigour.

29. At a second stage, work would be started on introducing field inspection tolerances.

Item 4 (c): Integration of pre-basic TC into the annexes

Document for this session: TRADE/WP.7/GE.6/2000/INF.7

30. The question was raised at the last session by the delegation of the Russian Federation and an informal document was prepared by the United Kingdom.

31. It was decided to agree the proposal as presented in the document and to include provisions to exempt pre-basic TC from provisions of sizing and presentation (see the annex to this report for the agreed text).

Item 4 (d): Discussion on areas of certification schemes that might benefit from further standardization

32. The delegation of France said that they would like to include provisions concerning superficial necrosis caused by the Tobacco Rattle virus (TRV) as this was an emerging quality problem.

33. The delegations of the Netherlands and United Kingdom said that applying (strict) tolerances for visual tuber symptoms, caused by TRV (spraing), is not effective in controlling this disease. It is generally assumed that the virus in such tubers cannot be transmitted to the progeny. However, the virus might be spread by infected but symptomless tubers.

34. The delegation of Canada said that this problem could be looked at based on information received from the questionnaires. He said that if the UN/ECE standard was a quality standard a tuber tolerance could be considered.

35. The delegation of the United States said that a conference will be held in April 2001, where this disease and other soil borne potatoes diseases will be discussed.

36. It was decided that France and the United States would prepare a document for the rapporteurs outlining the problem and making practical suggestions on how to control it with the help of the standard.

37. The delegation of the Russian Federation suggested the standardisation of methods for detection of viruses and pests as a possible new area of work.

38. The delegation of France supported this proposal. They said that for seed potatoes there was no equivalent organization to LISTA and therefore a small group could be given this responsibility.

39. The delegation of Canada said that work on this question should be done on the basis of the replies to the questionnaire.

40. The group noted the general interest on this matter and will come back to this question once sufficient replies to the questionnaire have been received. Most likely a working group will be formed to deal with this question.

Item 5: Routine procedures for sampling

Documents for this session: TRADE/WP.7/GE.6/2001/INF.3 (France, Netherlands, United Kingdom)

41. The rapporteurs from the Netherlands and France presented the finalized version of the annex on sampling to the Specialized Section. The annex was finalized with assistance from the rapporteur from the United Kingdom.

42. The Specialized Section agreed the proposed text (see the annex to this report) and congratulated the rapporteurs on their work.

Item 6: Questionnaire on certification schemes

Documents for this session: TRADE/WP.7/GE.6/2001/6 (Secretariat)

TRADE/WP.7/GE.6/2001/7 (Secretariat)

43. The secretariat reported that the questionnaire had been finalized, translated into French and Russian and been sent out as an official document. It will also be sent out to all Missions with a letter stating that the answers should be returned before the end of September. A special menu item will be created on the web site for the questionnaire.

44. The delegation of Poland said that they were currently redrafting their regulation and preferred to give the answers on the basis of the new regulation and would therefore not be able to reply until the second half of the year.

Item 7: Status of the revised UN/ECE Standard for Seed Potatoes, its promotion and future role

45. At the last meeting of the Specialized Section and at the meeting of rapporteurs in Moscow the role of the UN/ECE standard was discussed. It was decided to hold a coordination meeting with representatives of WTO, IPPC, EPPO and NAPPO to discuss the roles of the different organizations and closer cooperation. Unfortunately it had not been possible to establish contact with these organizations to invite them to this session.

46. There was a lengthy discussion on the issue and the following points/questions were raised:
- EPPO has published and adopted their certification scheme (1999). At present EPPO is working on a potato standard dealing mainly with phyto-sanitary measures. The EPPO Scheme makes reference to the UN/ECE standard saying that it complements it. What is the relationship of the two schemes?
 - What is the relationship to the NAPPO standard?
 - What can be the role of the UN/ECE standard?
 - Which authority is responsible if a trade dispute arises concerning application of the UN/ECE Standard.
47. Several delegations agreed that it was necessary to make a synthesis of the existing standards. On this basis the UN/ECE standard could be turned into a world standard for certification taking all relevant requirements into consideration. Then it should be possible to get recognition from WTO and IPPC as being responsible for the global coordination of seed potato certification.
48. The representative of the European Community reserved his position with respect to the components related to quarantine harmful organisms.
49. It was mentioned that EPPO, NAPPO and MERCOSUR were organizations with a regionally limited membership whereas more than two thirds of world trade in seed potatoes happens within the UN/ECE region.
50. The delegation of the United States said that to them the UN/ECE meetings were important to gather information on seed potato production beyond standardization.
51. Concluding this discussion the Chairman said that much had been done at this session to improve the standard. Work had been started on introducing subdivisions to classes, the annex on sampling had been adopted and work on test methods had been identified as interesting work for the future.
52. He said that the following tasks remained:
- to establish a good relationship with WTO;
 - to compare the UN/ECE standard with other standards;
 - to identify areas in the standard which need to be changed or complemented so that the standard can serve as reference to WTO.

Item 8: Implications of GMOs for the standard

53. Different delegations reported on the status of the regulation for GMOs:
- **Russian Federation:** No change since the last session. GMO varieties have been approved for consumption but not for production even though extensive field testing has been carried out.
 - **United States:** The industry is waiting for countries to decide whether GMOs are acceptable products for food.
 - **European Community:** Marketing of GMO is not prohibited provided these have been shown to be safe for the environment and human health but it has to be clearly marked that the varieties have been genetically modified. A threshold for accidental presence of GMO potatoes in conventional varieties is under consideration.

- **Switzerland:** Few GMO soybeans and corn have been allowed for animal feeds but cannot be cultivated in Switzerland. The threshold for accidental presence of authorized events is at 0.5% in non-GMO seed lots. An experiment on the validation of GMO seed testing and the implication for seed certification rules is under preparation.
 - **OECD Working Group:** Have not agreed on the threshold for accidental presence of GMO.
54. The Chairman invited a discussion on the three possible areas of impact of GMOs on the UN/ECE standard which were identified at the last session:
- identity of the GMO variety
 - labelling
 - tolerance of GMO in non-GMO variety.
55. The delegation of the United States said that in his country GMOs are considered as new varieties once they have been approved and do not have to be labelled specially. He said that tolerances for off-types already existed in the standard. Therefore he did not see the need for any special provisions. This view was supported by the delegations of Canada and the Netherlands.
56. The delegation of Canada said that in the case of seed potatoes the problem of varietal purity was less relevant because of the reproduction through cloning.
57. The delegation of the Russian Federation suggested that a small group should be formed which would look at the question of GMOs. He said that one should not ignore this question.
58. The delegation of Switzerland supported this idea and said that it was essential to verify whether the certification system in the UN/ECE standard still worked for GMOs. In all certification systems reference was made to varietal purity. It should be checked whether this can still be fulfilled.
59. It was decided to form a small group looking at issues related to GMOs as follows:
- identity of the variety
 - the impact of GMOs on the standard
 - the possibility to label the variety
 - to check whether the present system is still valid to assess varietal identity and purity.
60. Canada, the Russian Federation and the European Community agreed to participate in such a group.

Item 9: Concerns of seed buyers

Document for this session: TRADE/WP.7/GE.6/2001/INF.2 (Netherlands)

61. The delegation of the Netherlands presented their document in which they had summed up the concerns of Dutch seed buyers:
- seed vigour
 - tuber rots
 - blackleg
 - viruses
 - silver scurf
 - herbicides
 - quarantine organisms

62. They said that this list was not fundamentally different from the one presented by the delegation of the United Kingdom in the meeting of rapporteurs in Moscow.

63. The document was welcomed by the group. Additional areas of concern of seed buyers were mentioned as follows:

- rhizoctonia
- Mop Top virus
- superficial necrosis of viral origin
- homogeneity of the seed lot

64. The Chairman asked whether some of these concerns could be addressed in the standard. In the following discussion mainly “seed vigour” and “tuber rots” were dealt with.

65. Concerning seed vigour it was said that this was an important concern but unfortunately at the moment no scientific procedure existed for measuring it.

66. Concerning tuber rots it was said that these were difficult to predict on a given seed lot because it might come out of cold storage and look fine but then develop the rot some weeks later. Storage, transport and handling were identified as possible factors influencing rot.

67. The following were mentioned as possible ways to deal with tuber rots in the standard:

- low tolerances at shipment
- impose tolerances at destination
- recommend ways to assure the quality of production, storage, transport and handling.

68. It was decided to hold an exchange on quality assurance (based on a document from France) at the next session and to form a small group (Netherlands, United States, United Kingdom) who would look at destination tolerances for tuber rots.

Item 10: Development of explanatory material concerning diseases and parasites

69. The delegation of France presented their publication on potato diseases which had been created to avoid diverging interpretations of inspectors. They proposed to discuss whether the group should create an internationally harmonized version of this publication to facilitate harmonization of inspections.

70. In the discussion the proposal was welcomed. It was stressed that the group should limit itself to creating visual aids (colour charts, scab charts etc.) to provisions of the standard which would help to guarantee a harmonized application. Additionally it could be envisaged to make reference to the comprehensive volumes dealing with seed potato diseases.

71. The visual aids to be created should be practical and portable so that inspectors could carry them to the fields.

72. It was decided that the delegation of France would present a proposal to the next session identifying which areas of the standard might benefit of visual aids.

Item 11: Matters of interest arising from the work of other international organisations

73. The delegation of the European Community informed the meeting about the status of the legislation concerning GMO (see also para. 53)

Item 12: Preparation of the meetings of rapporteurs and the next session of the Specialized Section

(a) Date and place of the next meeting of rapporteurs and the Specialized Section

74. The delegation of the Netherlands supported by some other delegations said that they were concerned that the group was meeting too frequently and that this was one of the reasons for the low attendance. They proposed to hold one meeting of the Specialized Section per year but no meetings of the rapporteurs. Proposals could be prepared in small ad hoc groups.

75. The delegation of the United States asked if it would be possible to extend the meeting of the Specialized Section to three full days.

76. The secretariat replied that this was possible but that then some parts of the report would not be available in all languages and the final part might not be available at all at the reading of the report.

77. After some discussion the following was agreed:

- the Specialized Section will meet every year in early Spring; it will be a session of three days with discussions on Monday, Tuesday and Wednesday mornings and the reading of the parts of the report that are available on Wednesday afternoon;
- the Specialized Section will assign tasks to rapporteurs and ad hoc groups who will work independently or meet as necessary;
- the rapporteurs or ad hoc groups will report back to the bureau in early autumn;
- the bureau will meet together with some volunteers in autumn to prepare the meeting of the Specialized Section;

78. For 2001 the following meetings are planned:

- Milan (Italy), 28 May, meeting of the ad hoc group to develop a new introduction to the standard (Bureau, European Community)
- Changins (Switzerland), 17-19 September (Bureau, France, and possibly other volunteers)

79. It was also agreed that efforts should be made to increase participation to the group:

- delegations will provide the secretariat with addresses of possible participants;
- the secretariat will send invitations to all possible participants after the bureau meeting in September;
- the secretariat will establish contact with WTO.

(b) Establishment of long- and short-term objectives

80. For the future work it was decided to:

- rewrite the introduction of the standard to better reflect its purpose and scope (bureau, secretariat);
- investigate further the problem of superficial necrosis and the mop top virus (France, United States);
- compile the results of the questionnaire (bureau, secretariat);
- begin work on the standardization of methods (long term, on the basis of the results of the questionnaire, responsibility to be assigned);
- prepare a comparison between the UN/ECE and other standards (France);
- create an ad hoc group which would deal with issues related to GMOs (Canada, Russian Federation, European Community);
- hold an exchange on quality assurance (on the basis of a paper from France);
- create an ad hoc group which would propose destination tolerances to control tuber rots (Netherlands, United States, United Kingdom);
- prepare a proposal for the inclusion of visual aids in the standard (France);
- establish working relationships with WTO, IPPC, EPPO and NAPPO (bureau, secretariat).

Item 13: Preparation of the 57th session of the Working Party on Standardization of Perishable Produce and Quality Development

81. The secretariat will transmit the agreed amendments to the UN/ECE Standard for Seed Potatoes (see Annex) to the Working Party for adoption..

Item 14: Other business

82. No discussions were held under this item.

Item 15: Election of officers

83. The Specialized Section re-elected Mr. Pier Giacomo Bianchi (Italy) as its Chairman and Mr. Pierre Miauton (Switzerland) as its Vice-Chairman. The group decided not to elect a second vice-chairman.

Item 16: Adoption of the report

84. The Working Party adopted the report of its thirty-first session on the basis of a draft prepared by the secretariat.

ANNEX

Amendments to the UN/ECE Standard for Seed Potatoes agreed by the Specialized Section to be transmitted to the Working Party for adoption.

INTRODUCTION

Amend the third paragraph to read as follows:

“The standard contained in this document is a revision of the UN/ECE Standard for Seed Potatoes adopted by the Working Party at its 57th session in 2001. The standard introduces provisions for pre-basic TC seed potatoes and a new Annex X on sampling. A publishing history together with a list of related documents, may be found following the text of the standard.”

III. Provisions concerning sizing:

Add at the beginning: “Pre-basic TC are exempt from the minimum sizing requirements.”

V. Provisions concerning presentation:

Under (iii), amend the beginning as follows:

“With the exception of bags for Pre-Basic TC the packaging unit for bags shall be.....”

VI. Provisions concerning marking:

Amend the publishing history as follows: “Revised 1982, 1994, 1998, 2000, 2001”

Annex III:

Paragraph 2., insert a new (a) as follows:

“(a) in crop for the production of pre-basic TC seed, 0 per cent”.

The present (a), (b) and (c) become (b), (c) and (d) respectively.

Annex IV:

Insert the following at the beginning of the paragraphs:

| | |
|--|-----------------------|
| para. 1.: “- pre-basic TC | 1 per cent by weight” |
| para. 2.: “- pre-basic TC | 0 per cent by weight” |
| para. 3.: “- pre-basic TC | 3 per cent by weight” |
| para. 4.: “- pre-basic TC (0% surface cover) | 0 per cent by weight” |
| para. 5.: “- pre-basic TC (0% surface cover) | 0 per cent by weight” |
| para. 6.: “- pre-basic TC (0% surface cover) | 0 per cent by weight” |

In footnote 4:

Delete the reservation of Germany and Poland concerning a tolerance of 5% for powdery scab for basic and certified seed;
Delete "Greece" from the third line.
Add a new line as follows: "Greece in favour of a 1% tolerance for basic and certified seed."

Annex V:

Insert a new para. 1 as follows:

- "1. Pre-basic TC seed
- (a) The proportion, in direct progeny, of plants of other varieties should be 0 per cent.
(b) The proportion, in direct progeny, of plants showing symptoms of mild or severe virus diseases should be 0 per cent."

The present paragraphs 1 to 5 become 2 to 6 respectively.

Add a new paragraph 7 as follows:

- "7. The incidence of virus in the direct progeny may be determined by testing a sample of tubers from the crop for virus. Annex X describes the principles of developing a sampling regime for this purpose."

Add a new Annex X as follows:

"Annex X SAMPLING tubers for VIRUS testing

Introduction

In testing seed stocks for the incidence of virus, it is seldom feasible to test the entire stock, so a test is done on a sample from the stock. Ideally, only seed stocks with infection levels below the tolerance would be accepted and those above the tolerance rejected. However, taking a sample from a stock means that only an estimation of the actual incidence of virus can be made.

The reliability of this estimation will vary with the size of the sample, relative to the size of the lot, and the population standard which is set for the test. Defining an acceptable population standard for any sample entails two types of risk.

The first is that of rejecting a stock containing less virus than the tolerance and is often described as the "grower's" risk. The risk of accepting a stock containing more virus than the tolerance is known as the "buyer's" risk. From the point of view of classification authorities, this could also be described as the risk of passing a stock which fails to meet the official tolerances.

Such testing makes a number of important assumptions, which are, primarily, that the infected tubers are distributed homogeneously in the stock and that tubers are sampled randomly. In addition, the choice of the size of sample to be tested will need to be balanced by other practical factors such as cost, available facilities, labour, logistics of handling samples, seed stock size, etc.

The following tables and graphs illustrate some of the principles involved in sampling tubers for testing for virus.

Confidence limits

Testing different samples from the same seed stock will give a range of results which, statistically, will lie within a specific interval with a certain percentage confidence. This interval is known as the confidence interval.

The acceptable level of confidence or probability should be decided before the testing is conducted but 95% confidence/probability is normally used. The accuracy of the estimation can be improved by increasing the sample size and by adjusting the allowable number of infected tubers in the sample, i.e. the sample tolerance (Table 1).

For example, the confidence interval for a sample tolerance of 4% (4 allowable tubers) is 8.8% based on a sample of 100 tubers but, on a sample of 200 tubers, the interval decreases to 6% i.e. 7.7-1.7. The effect on the confidence interval of increasing the sample size does, however, become smaller at the larger sample sizes. Increasing the sample size from 100 to 200 tubers improves the accuracy of the estimation by 32 %, i.e. confidence interval reduced from 8.8 to 6.0%, whereas increasing the sample size from 300 to 400 tubers only gives an improvement of 15%.

In practice, therefore, the benefits of increasing the sample size have to be weighed up against the additional cost of the testing. The accuracy of the estimation can also be affected by changing the allowable number of infected tubers in the sample (table 1). For example, by decreasing the number of allowable tubers from 4 to 3, i.e. changing sample tolerance from 4 to 3 %, the confidence interval is decreased from 8.8 to 7.9 % and the confidence limits themselves become lower. Decreasing the allowable number of infected tubers in the sample also has a significant effect on the probability of classifying at higher tolerances than those allowed in the sample as illustrated in the next paragraph.

Table 1: Confidence limits, at a probability of 95%, for various sample tolerances of virus in relation to the size of the sample.

| Tolerance(%) for virus in a seed stock | Size of sample | Allowable no of infected tubers | Confidence limits | |
|--|----------------|---------------------------------|-------------------|------------|
| | | | Lower | Upper |
| 4 | 100 | 4(3) | 1.1(0.6) | 9.9(8.5) |
| | 200 | 8(7) | 1.7(1.4) | 7.7(7.1) |
| | 300 | 12(11) | 2.1(1.8) | 6.9(6.5) |
| | 400 | 16(15) | 2.3(2.1) | 6.4(6.1) |
| 10 | 100 | 10(8) | 4.9(3.5) | 17.6(15.2) |
| | 200 | 20(18) | 6.2(5.4) | 15.0(14.0) |
| | 300 | 30 | 6.9 | 13.8 |
| | 400 | 40 | 7.2 | 13.4 |

Probability of classifying stocks to meet specified tolerances

From the confidence intervals, it can be seen that classifying stocks based on a sample will contain a risk that some stocks, which fail a test, do, in fact, meet the tolerance and others, which pass, should fail. Table 2 and Figure 1 show the effect of varying sample size and the number of virus infected tubers allowed in the sample on the probability of classifying seed stocks with different incidences of virus infection. For example, in a test on a sample of 100 tubers where 3 virus infected tubers were allowed, there would be a 14% chance of classifying a stock containing 6% virus as meeting a tolerance of 4%.

Table 2: Probability of classifying seed stocks at two tolerances for virus based on a laboratory test in relation to the size of sample and the allowable number of virus-infected tubers in the sample:

| Tolerance (%) for virus in a seed stock | Size of sample | Allowable no of infected tubers | Probability of acceptance or classification | | | | | | |
|---|----------------|---------------------------------|---|-----|-----|-----|-----|----|----|
| | | | % infected tubers in stock | | | | | | |
| | | | 0.5 | 1 | 2 | 4 | 6 | 8 | 10 |
| 4 | 100 | 3 | 100 | 98 | 86 | 43 | 14 | 4 | 1 |
| | 200 | 7 | 100 | 100 | 95 | 45 | 8 | 1 | 0 |
| | 300 | 11 | 100 | 100 | 98 | 46 | 5 | 0 | 0 |
| | 400 | 15 | 100 | 100 | 99 | 46 | 3 | 0 | 0 |
| 10 | 100 | 8 | 100 | 100 | 100 | 98 | 85 | 59 | 32 |
| | 200 | 18 | 100 | 100 | 100 | 100 | 97 | 75 | 37 |
| | 300 | 30 | 100 | 100 | 100 | 100 | 100 | 91 | 55 |
| | 400 | 40 | 100 | 100 | 100 | 100 | 100 | 94 | 54 |

NOTE: The allowable number of tubers is, often, set at a lower level than the overall seed stock tolerance of 4 and 10% respectively, particularly in the case of a relatively small sample size. By lowering the tolerance in a sample the 'buyers risk' is reduced.

Figure 1: Probability of classifying seed stocks with different incidences of virus as meeting a tolerance of 4% or 10% for virus in a laboratory test in relation to the size of sample and the allowable number of virus infected tubers in the sample.

- a) tolerance up to 4%
- b) tolerance up to 10%

Figure 1a

BASIC SEED (4%)
Probability of classification

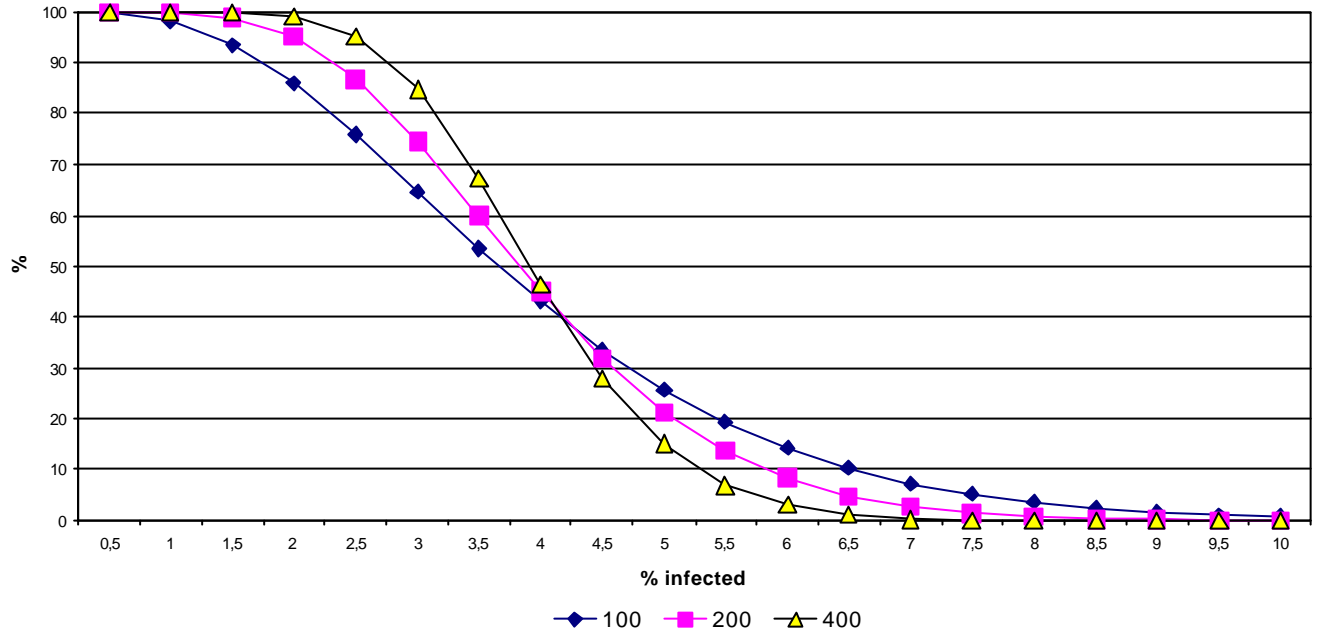


Figure 1b

CERTIFIED SEED(10%)
Probability of classification

