

◆ **EPPO Standards** ◆

CERTIFICATION SCHEMES

PATHOGEN-TESTED STRAWBERRY

PM 4/11(1) English



European and Mediterranean Plant Protection Organization
1, rue Le Nôtre, 75016 Paris, France

APPROVAL

EPPO Standards are approved by EPPO Council. The date of approval appears in each individual standard.

REVIEW

EPPO Standards are subject to periodic review and amendment. The next review date for this set of EPPO Standards is decided by the EPPO Working Party on Phytosanitary Regulations.

AMENDMENT RECORD

Amendments will be issued as necessary, numbered and dated. The dates of amendment appear in each individual standard (as appropriate).

DISTRIBUTION

EPPO Standards are distributed by the EPPO Secretariat to all EPPO Member Governments. Copies are available to any interested person under particular conditions upon request to the EPPO Secretariat.

SCOPE

EPPO Certification and Classification Schemes are intended to be used by National Plant Protection Organizations or equivalent authorities, in their capacity as bodies responsible for the design of systems for production of healthy plants for planting, for the inspection of such plants proposed for phytosanitary certification, and for the issue of appropriate certificates.

REFERENCES

OEPP/EPPO (1991) Recommendations made by EPPO Council in 1990: general scheme for the production of certified pathogen-tested vegetatively propagated ornamental plants. *Bulletin OEPP/EPPO Bulletin 21*, 757.

OEPP/EPPO (1992) Recommendations made by EPPO Council in 1981: certification of virus-tested fruit trees, scions and rootstocks. *EPPO Technical Documents* no. 1013, 42-43.

OEPP/EPPO (1993) Recommendations made by EPPO Council in 1992: scheme for the production of classified vegetatively propagated ornamental plants to satisfy health standards. *Bulletin OEPP/EPPO Bulletin 23*, 735-736.

DEFINITIONS

Certification scheme: System for the production of vegetatively propagated plants for planting, intended for further propagation or for sale, obtained from selected candidate material after several propagation stages under conditions ensuring that stated health standards are met. The filiation of the material is considered throughout the scheme.

Certified stock: Material which is produced from propagation stock under appropriate conditions.

Classification scheme: System for the production of vegetatively propagated plants for planting, intended for further propagation or for sale, obtained from selected candidate material after one or several propagation stages under conditions ensuring that stated health standards are met. Different classes may be defined according to the inspections and tests used, the tolerance levels applied and the precautions taken. The filiation of classified material is not considered.

Filiation: The line of descent from a defined parent plant.

Nuclear stock: Material individually tested by the most rigorous procedure in the scheme. Material propagated from nuclear stock may remain nuclear stock under appropriate conditions. All such material must be maintained at all times under strict conditions ensuring freedom from infection.

Propagation stock: Material derived from the multiplication of nuclear stock, under conditions ensuring freedom from infection. Pathogen freedom is checked by an appropriate procedure. Material derived from propagation stock under the same conditions remains propagation stock, but, according to the plant species concerned, a maximum number of generations of propagation may be fixed at this stage.

OUTLINE OF REQUIREMENTS

EPPO Certification and Classification Schemes describe the steps to be followed for the production of vegetatively propagated planting material of a particular cultivated plant, whose health status is attested by an official certificate. Certification and classification represent distinct alternative approaches to the production of healthy planting material. In a typical certification scheme, the certified material is descended by not more than a fixed number of steps from individual plants each of which is tested and found free from pests, and is then maintained and propagated under rigorous conditions excluding recontamination. In a classification scheme, the classified material is descended by one or more steps from material which, as a population, meets certain health standards and is maintained and propagated under conditions minimizing recontamination. In both cases, however, health status is attested by an official certificate. Which of the approaches is appropriate for a given cultivated plant depends on considerations of cost and resources, health status required, practical possibilities for testing, rate of recontamination, value of the final material.

EPPO Certification and Classification Schemes give details on the selection, growth and maintenance of the candidate material, and on the propagation of this material in several stages under conditions ensuring that stated health standards are met. Appropriate checks on specified pests are specified throughout the scheme. Information is provided, as necessary, on relevant pests, cultural practices, inspection and testing methods, recommended certification standards.

Certification scheme

PATHOGEN-TESTED STRAWBERRY

Specific scope

This standard describes the production of certified pathogen-tested material of strawberry.

Specific approval and amendment

First approved in September 1994.
Edited as an EPPO Standard in 1998.

The scheme is presented according to the general proposed by the EPPO Panel on Certification of Fruit Crops adopted by EPPO Council (OEPP/EPPO, 1992a). Certified strawberry material for export should in any case satisfy the phytosanitary regulations of importing countries, especially with respect to any of the pathogens covered by the scheme which are also quarantine pests.

Outline of the scheme

The certification scheme has the aim of providing strawberry plants which are true-to-type, free from virus diseases and substantially free from other pests. For the production of such certified pathogen-tested strawberry plants, the following successive steps should be taken:

1. Selection for pomological quality of individual plants of each cultivar to be taken into the scheme.
2. Selection for virus freedom among these plants by testing, or production of virus-free plants by heat treatment or an *in vitro* method, followed by testing. Alternatively, import of virus-free starting material from other countries. The plants thus shown to be virus-free are designated as nuclear stock.
3. Maintenance of the nuclear stock under conditions designed to prevent (re-)infection via pollen, aerial or soil vectors, with re-testing as appropriate.
4. Multiplication of the nuclear stock in one or more phases (propagation stock), under conditions ensuring freedom from (re-)infection, with retesting as appropriate.
5. Production of pathogen-tested plants (certified stock) under strict official control.
6. Issue of certificates for certified plants (runners) from these pathogen-tested plants. Certified strawberry material for export should in any case satisfy the phytosanitary regulations of importing countries, especially with respect to any of the pathogens covered by the scheme which are also quarantine pests.

These stages are illustrated in Fig. 1.

In the scheme, a specific terminology has been used for the successive stages of multiplication and certification: nuclear stock, propagation stock and certified stock. These terms have been defined in the Certification scheme for virus-free or virus-tested fruit trees and rootstocks (OEPP/EPPO, 1991).

Throughout the whole procedure, care should be taken to maintain the pomological characters of the originally selected plants. Checks should be built in on possible mutations or back mutations.

1. Selection of material

New or existing cultivars of strawberry (*Fragaria* × *ananassa*) may be selected as candidate material. The starting material should be selected visually on the basis of trueness to type, vigour, quality and absence of symptoms of pests. Alternatively, starting material may be obtained from existing certification schemes in other EPPO countries.

2. Production of nuclear stock

The candidate material for nuclear stock status should be kept under quarantine in an isolated suitably designed insect-proof glasshouse or gauzeshouse, separately from the nuclear stock. All plants should be grown in individual pots in a sterilized growing medium with precautions against infection by pests. Particular care should be taken to prevent infection by any of the pests listed in Appendix I. The general status of the plants with respect to these pests, and to other diseases or unknown symptoms, should be regularly checked by visual inspection.

All plants are individually tested (according to Appendix I) for the following virus diseases: arabis mosaic nepovirus, raspberry ringspot nepovirus, strawberry crinkle rhabdovirus, strawberry green petal MLO, strawberry latent ringspot nepovirus, strawberry mild yellow edge disease, strawberry mottle disease, strawberry vein-banding caulimovirus, tomato black ring nepovirus.

Material imported from outside the EPPO region should also be tested for all other viruses occurring naturally in strawberry in the region of origin.

All plants are also individually tested for *Phytophthora fragariae* var. *fragariae*, *Phytophthora cactorum*, *Colletotrichum acutatum*, *Ditylenchus dipsaci* and the following species of *Aphelenchoides*: *besseyi*, *blastophthorus*, *fragariae* and *ritzemabosi*.

The recommended test methods are given in Appendix I. Plants giving negative results in all tests should be transferred to a separate gauzehouse of similar standard (see Section 3). Plants giving positive results in any test should be removed immediately.

If no plants of a cultivar or clone prove to be free from these pathogens, heat treatment may be applied to eliminate infection. The plants resulting from heat treatment are considered again as candidate material and must be re-tested for the viruses above and re-assessed for agronomic and varietal characters.

Alternatively, meristem culture may be used to eliminate infection. In this case (Appendix III), the resulting nuclear stock plants are normally kept in tissue culture and should be re-tested for the viruses above. It should be noted that meristem culture is also very effective in eliminating fungal and bacterial diseases of strawberry, and foliage nematodes.

If no plants of a cultivar or clone prove to be free from the foliage nematodes *D. dipsaci*, *A. fragariae*, *A. besseyi*, *A. blastophthorus* or *A. ritzemabosi*, the plants may be treated according to the methods described in Appendix III (Elimination of foliage nematodes) and subsequently re-tested.

3. Maintenance of the nuclear stock

Nuclear stock plants should be kept in a suitably designed insect-proof house, containing only nuclear stock plants. They should be maintained under the same conditions and with the same checks on pest freedom as candidate nuclear stock plants. Nuclear stock plants of strawberry are normally propagated once a year by the first method mentioned in 4.1: some runners from each plant are retained to become the following year's nuclear stock plants, if grown under the same conditions and individually tested¹ at least for *P. fragariae* and for the aphid-transmitted viruses; other runners are taken as samples to test for foliage nematodes; the remainder will normally be used to produce propagation stock (Section 4). After propagation, the mother plant is removed (and may also usefully be tested for foliage nematodes). In general, any plant giving a positive result in a test or showing symptoms of any disease (fungal, bacterial, viral) in Table 2 should be eliminated.

Reserve nuclear stock may be maintained *in vitro* on a growing medium without hormones, at 2°C for 3-4 years without any sub-cultures, or for a longer period

with sub-cultures every 2 years. If such reserve material is to be removed from *in vitro* conditions and used for further propagation, it must be checked for trueness to type.

4. Multiplication of the material

4.1. Propagation stock I

Two methods for producing propagation stock I can be used:

Method 1. Runner tips from nuclear stock plants are pinned down in separate pots of sterilized growing medium. The pots in which runner tips are rooted are kept at a higher level than the nuclear stock pots to avoid transmission of soil or root pathogens through watering. When the runners have rooted, they are separated from the parent nuclear stock plants. These plantlets become the first stage of propagation stock I and are transferred to a separate insect-proof gauzehouse where they may be planted in runner beds of sterilized growing medium to act as mother plants for a second generation of propagation stock I (i.e. a maximum of two generations of propagation stock I).

Method 2. Multiplication entirely *in vitro*, beginning with meristems, apical tips or axillary buds (Appendix III) from nuclear stock plants. The number of reproduction cycles should be, at most, 10 (see Appendix III). The rooted plants transplanted out of the *in vitro* conditions become propagation stock I or II, depending on the demand for the number of plants. All plants produced by *in vitro* multiplication must be clearly designated as such. However, the progeny of such plants need not carry the designation, as trueness to type can be adequately determined within one multiplication step, provided an appropriate number of plants produces fruit.

Propagation stock I plants are randomly tested for *Phytophthora fragariae*. General precautions against pests should be maintained but plant protection products known to mask symptoms of *P. fragariae* or *Verticillium albo-atrum* should be avoided. Any plant showing symptoms of any disease or infested with any pest listed in Appendix II should be eliminated.

For foliage nematodes, visual inspection of plants in glasshouses may not be sufficient to detect their presence, as symptoms are not very pronounced under these conditions. Tests for these nematodes may be conducted at the stage when the progeny plants have been separated from the mother plants (see Section 3 and Appendix I).

¹ The possibility of infection by the other pests for which the candidate nuclear stock was tested should be considered; occasional re-testing is advised.

The filiation of the plants should be recorded so that each propagation stock I plant is known to be derived from nuclear stock by not more than a fixed number of generations (i.e. two generations in production method 1 above or ten generations in method 2). Additional generations may be permitted, by method 1, for cultivars that do not runner freely.

4.2. Propagation stock II

Plants of propagation stock II are produced by runnering from propagation stock I in as few generations as possible. The plants are produced under conditions which reduce the risk of aphid vectors and in soil or growing medium which has been sampled (Appendix I) and the samples found substantially free from nematode vectors of viruses. The plants are propagated on plots isolated by at least 50 m from other non-certified material of strawberry (this distance should be greater if *Phytophthora fragariae* is known to be present in the area).

General precautions against pests should be maintained but plant protection products known to mask symptoms of *V. albo-atrum* and *P. fragariae* should be avoided. Propagation stock II plants should be inspected regularly and should conform with the recommended certification standards in Appendix II.

5. Production of certified stock

Plants of certified stock, which are the final stage of the certification scheme and can only be used to produce certified plants (runners) for fruit production, are produced by runnering from propagation stock II. The plants are propagated on plots isolated by at least 50 m from other non-certified material of strawberry (this distance should be greater if *P. fragariae* is known to be present in the area). The soil should have been sampled (Appendix I) and the samples found substantially free from nematode vectors of viruses.

Precautions should be taken to avoid, as much as possible, infestation by aphid vectors of strawberry viruses and by *Meloidogyne hapla* (e.g. treatment at an appropriate time with a suitable plant protection product).

General precautions against pests should be maintained and the plants should be inspected regularly and be found to conform with the recommended certification standards in Appendix II. It may be useful to allow such plants to fruit. Any plant showing symptoms of pests which are listed in Table 2 should be eliminated. Plants should be substantially free from *Sphaerotheca alchemillae* and *Tetranychus urticae*.

Certified plants (runners) may be held for a certain period before sale under refrigeration or in waiting beds under the same conditions as certified stock.

Throughout the production of propagation and certified stock, checks should be made on varietal purity and on possible mutations or back mutations and on June yellows. Special care should be taken in the case of material from *in vitro* multiplication.

Inspection for the granting of certificates should be performed in early summer.

APPENDIX I

Guidelines on testing procedures

Testing for viruses on indicator plants

Viruses occurring specifically in strawberry are tested for by means of mechanical inoculation onto suitable sensitive herbaceous indicators or foliage grafting on *Fragaria* indicators. A compilation of well tested indicators and instructions on use of the foliage-grafting technique can be found in Converse (1987) (from which Table 1 has been adapted).

In general, all strawberry viruses occurring in the EPPO region can be detected by leaf-grafting to the hybrid clones UC4 or UC5, *Fragaria vesca* EMC or *Fragaria vesca* var. *semperflorens* Alpine (for aphid-borne viruses), by mechanical inoculation to *Chenopodium quinoa* (for nepoviruses) and by visual observation of symptoms (for MLOs). For identification of the viruses, serological methods or other indicators shown in Table 1 can be used.

Phytophthora fragariae

The fungus be detected by applying the test method of Duncan (1980). Root tips (2.0-2.5 cm long) are cut from the plants for test and mixed with a soil-free compost (1:3 sand/peat, plus fertilizers, trace elements and lime; final pH 5.5). The mixture is put into 12.5-cm plastic pots and each pot is planted with 5 plants, about 7.5-10.0 cm tall of *F. vesca* var. *semperflorens* cv. Baron Solemacher, grown from seed or of a susceptible runnering hybrid clone (e.g. UC5). The seedlings should have been transplanted into trays of compost 2-3 weeks after sowing and grown for 4-6 weeks in a growth cabinet at 20°C under continuous light (8000 lux). All crowns but one and all old leaves on each plant are removed before use. The pots are placed on a bench designed to collect all pot drainage water to minimize local contamination. Glasshouse temperature is maintained at 15°C. Plants are watered by mist irrigation for 15 min every 6 h. After 5 weeks the roots of each bait plants are examined for the typical red steles and oospores. Control plants grown in compost alone should be placed at random among test plants to detect the possibility of cross contamination.

Phytophthora cactorum

Three leaf bases are removed from each of the plants to be tested and are covered with tap water or sterile soil water in a Petri dish. After incubation in the light at

ambient laboratory temperature (20-25°C), they are examined each day for sporangia of *P. cactorum*, and discarded after 3 days.

Colletotrichum acutatum

Strawberry plants may harbour this pathogen in a quiescent state in the form of inconspicuous lesions on any part of the plant and infection cannot be detected reliably by visual examination. The pathogen is found most frequently at the bases of older leaf stalks. Sporulation can be stimulated by treatment with paraquat herbicide before incubation, as follows.

A sample for testing is obtained by removing the oldest still living leaf stalk (petiole) from each plant. The basal 2 cm of each petiole, including stipules, is excised. These are washed, surface-sterilized, and washed again. The petiole bases are then immersed for 1 min in a solution of paraquat diluted 1:40 with water. They are then washed and incubated on damp paper in plastic boxes at 25°C in constant light for 6 days. The incubated petiole bases are then examined microscopically for acervuli bearing characteristic conidiophores and conidia.

Leaf nematodes (Ditylenchus dipsaci, Aphelenchoides besseyi, A. blastophthorus, A. fragariae and A. ritzemabosi)

Young folded leaves and buds are collected from the crown of the plant to be tested, and also the tips and nodes of runners. If the plant can be destructively sampled, all such tissue is removed; otherwise (if the tested plant is to be retained, as in the case of candidate nuclear stock plants), approximately 50% of the appropriate tissue is collected. The tissue is cut up with a pair of scissors and distributed on muslin or nylon sieve, which is placed in a funnel of water containing 0.15% H₂O₂ so that the tissue is just immersed. A piece of rubber tube is attached to the stem of the funnel and is closed with a spring clamp. Any nematodes present will leave the tissue and gather in the stem of the funnel; they can be collected after 2-5 days by releasing a small amount of water from the tube by means of the clamp.

Examination of the sample can be performed with a dissecting microscope at 50x and any nematodes found should be mounted on a microscope slide and identified at a higher magnification. Identification to species can only be done by a trained taxonomist.

Soil testing for virus-vector nematodes

Soil in which propagation stock II and certified stock is to be planted should be sampled and the samples found substantially free from the following species of nematode vector: *Xiphinema diversicaudatum* (the vector of arabis mosaic and strawberry latent ringspot nepoviruses), *Longidorus macrosoma* (raspberry ringspot nepovirus), *L. attenuatus* (tomato black ring nepovirus) and *L. elongatus* (raspberry ringspot and

tomato black ring nepoviruses). The test procedure to be followed is given in the relevant part of the EPPO certification scheme for virus-free or virus-tested fruit trees and rootstocks (OEPP/EPPO, 1992b).

The nematodes can be tested directly for the presence of virus by a 'slash test', i.e. breaking up small numbers of nematodes in phosphate buffer (pH 6.9) and inoculating virus-indicator plants with the suspension (Taylor, 1964).

APPENDIX II

Recommended certification standards for strawberry

Nuclear stock

Records must show that all nuclear stock plants were negative when tested for all listed viruses and virus-like agents, for *Phytophthora fragariae* var. *fragariae*, *P. cactorum*, *Colletotrichum acutatum*, *Aphelenchoides* spp. and *Ditylenchus dipsaci*. No plant may show any symptom of fungal, bacterial or viral disease, or of infestation by any pests in Table 2. All plants should also be substantially free from other pests. If these conditions are not met at the time of the certification inspection, certification will be refused.

Propagation stock I

Random testing for *Phytophthora fragariae* should be performed. If any plant gives a positive test result, certification will be refused to the whole bed. No plant may show any symptom of infestation by any pest in Table 2. All plants must also be substantially free from other pests. If these conditions are not met at the time of the certification inspection, certification will be refused to the whole bed.

Propagation stock II

Infestation by various pests should not exceed the limits indicated in Table 2 at the time of the certification inspection. If the limits are exceeded, certification will be refused to the whole bed.

Certified stock

At the certification inspection, infestation by various pests should not exceed the limits indicated in Table 2. If the limits are exceeded, certification will be refused to the whole bed. The same certification standards apply to the certified runners as to the certified stock mother plants.

APPENDIX III

Guidelines on sanitation procedures

In vitro propagation of strawberry

In vitro multiplication of strawberry includes four stages, of which the first is normally 'regeneration', i.e. elimination of viruses, and the last three are micropropagation as such. The following is an example of how such propagation can be performed.

1. Regeneration

Mother plants are selected in production fields. Meristems of 0.1-0.3 mm are collected, disinfected and cultured. The main aim is to exclude pathogens such as viruses, MLOs, fungi and foliage nematodes. Apical tips (larger than 0.3 mm) or axillary buds can also be cultured by the same methods but will not exclude foliage nematodes and so must be taken from nuclear stock plants tested for foliage nematodes. In principle, a pathogen-free nuclear stock plant can also be put into meristem-tip culture by the same method.

2. Multiplication

The microplant obtained from meristem culture is transferred to a proliferation medium containing growth regulators (indole butyric acid, benzylaminopurine, gibberellic acid). Up to 10 multiplication steps can be achieved, but this figure should not be exceeded. In any case, stocks are renewed at least every 2 years.

3. Rooting

Explants are pricked out on a medium without benzylaminopurine, containing indole butyric acid to favour rooting.

4. Planting out

When the plants reach 3-4 cm and are well rooted, they are transplanted into peat blocks in the glasshouse at high RH. Such plants are considered as *in vitro* propagation stock.

The success rate at the different stages is variable, but can be 90-95%. *In vitro* culture of strawberry can present problems (e.g. loss of trueness to type, abnormal behaviour of the micropropagated plants). For this reason, it is important to use culture media with relatively low hormone content, to limit the number of propagation steps and to prevent the formation of callus. With these precautions, *in vitro* multiplication can be perfectly satisfactory to produce certified material.

Elimination of foliage nematodes

If no plants of a cultivar or clone prove to be free from the foliage nematodes *Ditylenchus dipsaci*, *Aphelenchoides fragariae*, *A. besseyi*,

A. blastophthorus or *A. ritzemabosi*, the following treatment can be applied: remove the plant from its pot and wash the roots clean of soil or growing medium; cut through the crown (i.e. the compressed stem) below the level of all green tissue; discard the upper part and replant the roots and crown base in fresh growing medium; maintain at 20°C for 4 weeks to allow regeneration of the leaves and runners.

References

- CONVERSE, R.H. (1987) *Virus Diseases of Small Fruits*. USDA Agriculture Handbook no. 631, pp. 3-4. USDA, Washington (US).
- DUNCAN, J.M. (1980) A technique for detecting red stele (*Phytophthora fragariae*) infection of strawberry stocks before planting. *Plant Disease* **64**, 1023-1025.
- OEPP/EPPO (1991) Certification schemes. No. 1. Virus-free or virus-tested fruit trees and rootstocks. Part I. Basic scheme and its elaboration. *Bulletin OEPP/EPPO Bulletin* **21**, 267-277.
- OEPP/EPPO (1992a) Recommendations made by EPPO Council in 1981: certification of virus-tested fruit trees, scions and rootstocks. *EPPO Technical Documents* no. 1013, 42-43.
- OEPP/EPPO (1992b) Certification schemes. No. 1. Virus-free or virus-tested fruit trees and rootstocks. Part IV. Technical appendices and table of contents. *Bulletin OEPP/EPPO Bulletin* **22**, 277-283.
- TAYLOR, C.E. (1964) Transmission. In *Report of the Scottish Horticultural Research Institute for 1963/1964*, p. 65. SCRI, Dundee (GB).

Table 1. Recommended methods of detection and identification of strawberry viruses and virus-like agents. Adapted from Converse (1987)

Pathogen	Symptoms in cvs ¹	Mechanical inoculation to herbaceous hosts	Indicators for leaf graft transmission ²	Notes
Virus and virus-like agents occurring in the EPPO region and which are tested for in this scheme				
<i>Aphid-borne</i>				
Strawberry crinkle rhabdovirus	–	–	4, 5	Petal streak
Strawberry mild yellow edge	–	–	4, 5	UC-6 latent
Strawberry mottle	–	–	4, 5	by Cf
Strawberry vein-banding caulimovirus	–	–	6, 12	10,11 latent
<i>Leafhopper-borne</i>				
Strawberry green petal MLO	+	–	–	Distinguish on herbaceous hosts
<i>Nematode-borne</i>				
Arabis mosaic nepovirus	–	+	–	
Raspberry ringspot nepovirus	–	+	–	
Strawberry latent ringspot nepovirus	–	+	–	
Tomato black ring nepovirus	–	+	–	
Virus and virus-like agents not present in the EPPO region and only to be tested for in imported material				
<i>Aphid-borne</i>				
Pseudo mild yellow-edge	–	–	4, 12, Alp	10, 11 latent
Strawberry latent C	–	–	5, EMC	
<i>Leafhopper-borne</i>				
Aster yellows MLO	+	–	–	Distinguish by electron microscopy
Lethal decline	+	–	–	
Mycoplasma yellows	+	–	–	
Rickettsia yellows	+	–	–	
<i>Nematode-borne</i>				
Tomato ringspot nepovirus	–	+	4, 5, Alp	
<i>Vector unknown</i>				
Chlorotic fleck	–	–	EMB, EMK	
Leafroll	+	–	5	
Witches' broom	+	–	4, 5	
Multiplier plant	+	–	–	
Feather-leaf	+	–	Alp, 4, 1	
Pallidosis	–	–	10, 11	
Tobacco streak	–	+	Alp, 4	

¹ The cultivar itself develops symptoms that enable the causal agent to be identified.

² Abbreviations for strawberry indicators. Numbers = UC indicator clones 1-12; Alp = *F. vesca* var. *semperflorens* 'Alpine'; EMB, EMV, EMK = various clones of *F. vesca* 'East Malling clone'; Cq = *Chaetosiphon fragaefolii* (for further details, see Converse, 1987).

Table 2. Suggested tolerances in visual inspection for strawberry pests at different stages of certification

		% plants			
		NS	PSI	PSII	CS
Viruses	Listed for strawberry in Table 1	0	0	0	2
MLOs	Listed for strawberry in Table 1	0	0	0	1
Bacteria	<i>Xanthomonas fragariae</i>	0	0	0	0
Fungi	<i>Colletotrichum acutatum</i>	0	0	0	0
	<i>Phytophthora cactorum</i>	0	0	0	1
	<i>Phytophthora fragariae</i> var. <i>fragariae</i>	0	0	0	0
	<i>Verticillium dahliae</i> & <i>V. albo-atrum</i>	0	0	0	2
Arthropods	<i>Rhizoctonia fragariae</i>	0	0	0	1
	<i>Chaetosiphon fragaefolii</i>	0	0	1	1
	<i>Tarsonemus fragariae</i>	0	0	0	0.1
Nematodes	<i>Aphelenchoides</i> spp.	0	0	0	0
	<i>Ditylenchus dipsaci</i>	0	0	0	0

NS = nuclear stock; PSI = propagation stock I; PSII = propagation stock II; CS = certified stock.

Note: a new disease, leaf marginal chlorosis, has recently been observed in Spain and in France. It has been described in France and is caused by a phloem-limited bacterium. Tolerances have not yet been established.

Fig. 1. Diagram of the strawberry certification scheme

