

INTERNATIONAL STANDARDS FOR PHYTOSANITARY MEASURES

[PARAGRAPH 1] PEST FREE POTATO MICROPROPAGATIVE MATERIAL AND MINITUBERS FOR INTERNATIONAL TRADE

(200-)

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INTRODUCTION

[3]

SCOPE

[5] This standard provides guidance on the production, maintenance and certification of pest free potato (*Solanum* spp.) micropropagative material and minitubers intended to be moved in international trade.

[6] This standard does not apply to movement of field-grown seed potatoes or to potatoes intended for consumption or processing.

REFERENCES

[8] *Guidelines on lists of regulated pests*, 2003. ISPM No. 19, FAO, Rome.

[9] *Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms*, 2004. ISPM No. 11, FAO, Rome.

[10] *Pest risk analysis for regulated non-quarantine pests*, 2004. ISPM No. 21, FAO, Rome.

[11] *Requirements for the establishment of pest free places of production and pest free production sites*, 1999. ISPM No. 10, FAO, Rome.

[12] *The use of integrated measures in a systems approach for pest risk management*, 2002. ISPM No. 14, FAO, Rome.

DEFINITIONS

[14] Definitions of phytosanitary terms used in the present standard can be found in ISPM No. 5 (*Glossary of phytosanitary terms*).

[15] For the purpose of member consultation, this section also contains terms or definitions that are new in the present draft standard. Once this standard has been adopted, these new terms and definitions will be transferred into ISPM No. 5, and will not appear in the standard itself.

[16] potato micropropagative material **Plants *in vitro*** of tuber-forming *Solanum* spp. (includes microtubers)

[17] microtuber A tuber produced *in vitro* from **plants *in vitro*** of tuber-forming *Solanum* spp.

[18] minituber A tuber produced in a protected environment from potato micropropagative material

[19] seed potatoes Tubers (including minitubers) and potato micropropagative material of cultivated tuber-forming *Solanum* spp. for planting

OUTLINE OF REQUIREMENTS

[21] Facilities used for the production of potato micropropagative material should be officially authorized or operated directly by a National Plant Protection Organization (NPPO). The NPPO of the exporting country is responsible for the operation or supervision of these facilities. Pest risk analysis (PRA), carried out by the importing country, should form the basis for specific phytosanitary measures for specified and regulated pests in trade of potato micropropagative material and minitubers.

[22] The primary phytosanitary measures for managing risks related to potato micropropagative material include testing for the pests specified and regulated by the importing country, and management systems for the maintenance and propagation of potato micropropagative material derived from pest free candidate plants in a closed, sterile environment. For the production of minitubers, measures include origin from pest free potato micropropagative material and production in a pest free production site.

[23] Facilities for the establishment of pest free potato micropropagative material and testing for pest freedom are subject to strict requirements to prevent cross-contamination or infection of material. Facilities for maintenance and propagation of pest free potato micropropagative material are also subject to stringent requirements to maintain phytosanitary security. Staff should be trained and competent in techniques for the establishment of pest free plants *in vitro*, the maintenance of pest free potato micropropagative material, the production of pest free minitubers, diagnostic testing as required, and in following administrative,

management and record-keeping procedures. The management system, and the policies and objectives of each facility and the testing laboratory, should be defined in a management systems manual. Throughout all production and testing, the identity of all propagative material should be preserved, and traceability should be maintained through adequate documentation.

- [24] All facilities should be officially audited at least once every 12 months. In addition, potato micropropagation facilities should be officially examined to ensure that each lot of micropropagative material is free from the specified and regulated pests and, if appropriate, complies with the requirements of the seed potato certification scheme of the exporting country. Pest free potato micropropagative material and minitubers moving in international trade may be required to be accompanied by a phytosanitary certificate. The use of seed certification labels would assist with lot identification.

[25] **BACKGROUND**

[26] Many pests have been reported to be associated with cultivated potato (*Solanum tuberosum* and related tuber-forming species) worldwide. Because potatoes are propagated mainly by vegetative means, there is considerable risk of spreading pests by international trade of seed potatoes. However, potato micropropagative material produced using certain techniques and under certain criteria that employ appropriate phytosanitary measures (usually within a seed potato certification scheme) may be considered free from all pests specified (e.g. within the parameters of a certification scheme). Trade of such material reduces the risk of regulated pest introduction and spread. Potato micropropagative material can be multiplied under specified protected conditions to produce minitubers. Provided that minituber production is carried out under pest free conditions, minitubers can also be traded with minimum risk.

[27] **REQUIREMENTS**

[28] **1. Responsibilities**

[29] Only facilities officially authorized or operated directly by a National Plant Protection Organization (NPPO) should be recognized for the production of potato micropropagative material as described in this standard. The NPPO of the exporting country is responsible for auditing the phytosanitary aspects of these facilities and for the phytosanitary aspects of any related seed potato certification scheme. The NPPO of the importing country is responsible for pest risk analysis (PRA) and should, on request, have access to documentation and facilities to enable it to verify that the level of phytosanitary security in the exporting country meets its requirements.

[30] **2. Pest Risk Analysis**

[31] PRA is the basis for requiring specific phytosanitary measures for specified pests in trade of potato micropropagative material and minitubers. PRA should be carried out by the importing country in accordance with ISPM No. 11 (*Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms*, 2004) for the pathways of “potato micropropagative material” and “minitubers” from given origins. The PRA may identify pathway-specific quarantine pests. The PRA should also be carried out in accordance with ISPM No. 21 (*Pest risk analysis for regulated non-quarantine pests*) as appropriate in order to identify regulated non-quarantine pests that may be specified, for example, in a seed potato certification scheme of the importing country.

[32] **2.1 Pathway-specific lists of potato pests**

[33] The NPPO of the importing country should, on the basis of the above-mentioned PRAs, specify through regulated pest lists the pests that are regulated for potato micropropagative material and minitubers respectively. Guidance on regulated pest lists is provided in ISPM No. 19: *Guidelines on lists of regulated pests*.

[34] **2.2 Risk management options**

[35] The risk management measures are determined based on the PRA. It may be appropriate for the measures to be integrated into a systems approach (as described in ISPM No. 14: *The use of integrated measures in a systems approach for pest risk management*).

[36] **2.2.1 Potato micropropagative material**

[37] The primary phytosanitary measures for managing risks related to potato micropropagative material include:

- testing individual candidate plants for the pests specified and regulated by the importing country
- management systems for the maintenance and propagation of pest free potato micropropagative material in a closed, sterile environment.

[38] **2.2.2 Minitubers**

[39] The primary phytosanitary measures for managing risks related specifically to minituber production should take into account any pest risk assessment information related to the area of production and include:

- origin from pest free potato micropropagative material as part of a seed potato certification scheme, if appropriate
- production in pest free growing medium under a protected environment operated as a pest free production site free from the pests (and their vectors) specified and regulated by the importing country for minitubers.

[40] **3. Production of Pest Free Potato Micropropagative Material**

[41] **3.1 Establishment of pest free potato micropropagative material**

[42] Candidate plants, from which the pest free plants *in vitro* are derived, should be grown through a complete vegetative cycle, inspected and found free from pests¹. As well as the laboratory testing procedure for specified pests described below, potato plants *in vitro* should be inspected and found practically free from all other pests and from general microbial contamination.

[43] **3.1.1 Testing**

[44] A testing programme should be applied in an officially operated or authorized testing laboratory. This laboratory should meet recommended conditions (described in Annex 1) to ensure that all material moved into the facility and held as individual potato micropropagative material is free from the pests specified and regulated by the importing country and, if appropriate, from the pests specified in the seed potato certification scheme of the exporting country. The pests concerned are those that are not consistently excluded by conventional micropropagation, for example, viruses, viroids, phytoplasmas and some bacteria. A list of examples of the most common pests of concern to potato micropropagative material is provided in Appendix 1.

[45] **3.1.2 Secure phytosanitary environment**

[46] A facility used to establish pest free plants *in vitro* from new candidate material should be authorized by the NPPO specifically for this purpose. The facility should provide a secure phytosanitary environment for establishing individual plants *in vitro* from previously untested candidate plants and for holding these plants while awaiting required test results. Because both infected and pest free potato propagative material (tubers, plants *in vitro* etc.) may be handled in the same facility, strict procedures should be implemented to prevent cross-contamination or infection of pest free material. Such procedures should include:

- control of the entry of staff and provision for the use of protective clothing, disinfection of footwear and hand washing on entry (with particular care being taken if staff members work in areas of higher phytosanitary risk, e.g. the testing facility)
- chronological records of actions in handling material so that production can, if necessary, be checked easily for cross-contamination and infection if pests are detected
- stringent aseptic techniques, including sterilization of instruments by autoclaving or by using a glass-bead sterilizer² between materials of a different pest status
- disinfection of work areas between handling material of a different pest status.

[47] **3.2 Maintenance and propagation of pest free potato micropropagative material**

[48] A facility that maintains and propagates pest free micropropagative material should be operated as a pest free production site (as described in ISPM No 10: *Requirements for the establishment of pest free places of production and pest free production sites* for general requirements) with respect to the pests of potato specified and regulated by the importing country for potato micropropagative material. The facility should:

- maintain and propagate only officially certified pest free potato micropropagative material and permit only pest free material to enter the facility
- grow other plant species only if this is officially permitted and if:
 - the phytosanitary risks for potato propagative material have been assessed and if identified, the plants have been tested and found to be pest free before entering the facility
 - adequate precautions are taken to separate them in space or time from the potato plants
- operate separately from the facilities that establish plants *in vitro* and conduct the testing for pests
- implement officially approved operational procedures to prevent entry of pests
- control the entry of staff and provide for the use of protective clothing, disinfection of footwear and hand washing on entry (with particular care being taken if staff members work in areas of higher phytosanitary risk, e.g. the testing facility)
- use aseptic procedures

¹ Where candidate material is determined to be infested with certain types of pest, it may be feasible, at the discretion of the NPPO, for officially recognized techniques (e.g. meristem tip culture and thermotherapy) to be used in combination with conventional micropropagation to remove or eliminate the pest from the candidate material, and prior to the initiation of the *in vitro* multiplication programme. In such cases, laboratory testing must be used to confirm the success of this approach before multiplication commences.

² Flame sterilization using methanol/ethanol may not always be effective.

- implement and keep documentary records of regular management system checks by the manager or designated, responsible staff member to ensure that phytosanitary security is maintained.

[49] **3.3 Combined establishment and maintenance facilities**

[50] Establishment facilities may also maintain pest free plants *in vitro* provided that strict procedures are adopted to prevent cross-infection of maintained pest free plants *in vitro* from material of a lower plant health status.

[51] These strict procedures include:

- the use of separate laminar flow cabinets and instruments for the maintained material and for material of a lower plant health status
- scheduled audit tests on the material maintained.

[52] Pest free plants *in vitro* established and maintained in these facilities may be propagated further to produce minitubers, or may be internationally traded as such with appropriate documentation (further described in section 6).

[53] Additional requirements for micropropagation facilities are provided in Annex 2 and may be required depending on the pests present in the area and the results of PRA.

[54] **4. Production of Pest Free Minitubers**

[55] The following guidance for minituber production also applies to parts of minitubers, such as sprouts.

[56] A minituber production facility should be operated as a pest free production site (as described in ISPM No. 10: *Requirements for the establishment of pest free places of production and pest free production sites* for general requirements) with respect to pests specified for minitubers and regulated by the importing country and, if appropriate, the pests specified in the seed potato certification scheme of the exporting country. The pests commonly specified include those for micropropagative material (i.e. viruses, viroids, phytoplasmas and bacteria, listed in Appendix 1) and also fungi, nematodes, arthropods etc. (Appendix 2).

[57] The only potato germplasm allowed to enter the facility should be pest free potato micropropagative material. Plants of other plant species may be permitted to be grown in the facility provided that:

- the phytosanitary risks for minitubers have been assessed and if identified, the plants have been tested and found to be pest free before entering the facility
- adequate precautions are taken to separate them in space or time from the potato plants.

[58] A systems approach (as described in ISPM No. 14: *The use of integrated measures in a systems approach for pest risk management*) may be required to reduce the risk of introduction of the specified and regulated pests. Production should be in a protected environment and additional precautions, depending on conditions in the area of production, may include:

- location of the facility in a pest free area, or an area that is free from or well isolated from sources of the specified pests
- a buffer zone around the facility for specified pests
- location of the facility in an area with low pest and pest vector pressure
- production timed to take place at a time of year when there is low pest and pest vector pressure.

[59] However, if the facility includes adequate physical and operational safeguards against the introduction of the specified and regulated pests, these additional measures may not be required.

[60] The pest free production site should be a growth room, glasshouse or (if appropriate, based on local pest status) a screen house, constructed and maintained to prevent the entry of pests. The entry of staff to the facility should be controlled and provision should be made for use of protective clothing, disinfection of footwear and hand washing on entry. It should also be possible to decontaminate the facility if required. The growing medium, water supply and fertilizer used in the facility should be pest free.

[61] The facility should be monitored for the specified and regulated pests and pest vectors during the production cycle and, if necessary, pest control measures or other corrective actions should be undertaken and documented. The facility should be cleaned after each production run.

[62] The minitubers should be handled, stored, packed and transported under conditions preventing infestation by the specified and regulated pests.

[63] Additional requirements for minituber production are provided in Annex 3.

[64] **5. Staff Competence**

[65] Staff should be trained and competent in:

- techniques for the establishment of pest free plants *in vitro*, the maintenance of pest free potato micropropagative material, the production of pest free minitubers, and diagnostic testing as relevant
- following administrative, management and record-keeping procedures.

[66] Records of staff training and competencies should be maintained as determined by the NPPO.

[67] **6. Documentation**

[68] The phytosanitary management system, and the policies and objectives of each facility and the testing laboratory, should be defined in a management systems manual. In developing such a manual, procedures should be produced and described for:

- the establishment, maintenance and propagation of pest free plants *in vitro* with particular attention paid to those control measures used to prevent cross-infection between the pest free potato micropropagative material and any material of a lower phytosanitary status
- the production of pest free minitubers, covering management, technical and operational procedures, with particular attention paid to those control measures used to prevent pest infection, infestation and contamination of the minitubers during their production, harvest and storage, and during transport to their destination
- all laboratory test procedures.

[69] Throughout all production and testing, the identity of all propagative material should be preserved and traceability should be maintained by adequate documentation. Records of all tests done on the material, as well as the results and lineage, should be kept in a manner that ensures traceability for the importing country for at least five years. For potato micropropagative material, the records that determine its pest free status should be maintained for as long as the micropropagative material is maintained.

[70] **7. Auditing**

[71] All facilities and operational systems should be officially audited by the NPPO of the exporting country at least once every 12 months to ensure compliance with the procedures and maintenance of the pest free status of the plants.

[72] In some circumstances the importing country may request to participate in such an audit.

[73] **8. Official Verification of Pest Freedom**

[74] The potato micropropagation facility should be officially examined to ensure compliance with the procedures and that each lot of micropropagative material meets the importing country requirements for freedom from the specified and regulated pests. In addition, if appropriate, compliance with the phytosanitary requirements of the seed potato certification scheme of the exporting country may also have to be officially verified.

[75] The potato minituber production facility, relevant records, the growing crop, and each lot of minitubers should be officially inspected to ensure that the lot is free from the specified pests. In addition, if appropriate, compliance with the phytosanitary requirements of the seed potato certification scheme of the exporting country may also have to be officially verified.

[76] **9. Certification**

[77] Pest free potato micropropagative material and minitubers moving in international trade may be required to be accompanied by a phytosanitary certificate issued by the NPPO of the exporting country that complies with the requirements of the importing country. The use of existing seed certification labels would assist with lot identification, in particular when these labels specify the reference number of the lot, including where appropriate the producer's identification number. It is recommended that such reference numbers also appear on any phytosanitary certificates issued.

[78]
[79]

CRITERIA FOR OFFICIAL TESTING LABORATORIES

- [80] The requirements for official testing laboratories operated or authorized by NPPOs include the following:
- competent staff with knowledge and experience of conducting appropriate microbiological, serological, molecular and bioassay tests, and interpreting the results
 - adequate and appropriate equipment to conduct microbiological, serological, molecular and bioassay tests
 - relevant validation data for the tests conducted
 - procedures to prevent cross-contamination of samples
 - isolation from production facilities
 - a management systems manual that describes policy, organizational structure, work instructions, and testing standards and any quality management procedures.

[81]

[82]

REQUIREMENTS FOR MICROPROPAGATION FACILITIES

[83] The requirements for micropropagation facilities include, as appropriate, depending on the presence of pests in the area and the results of PRA, the following conditions for the physical structure, equipment and operating procedures:

- a double door entry with an air-curtain and with a changing area between the double doors
- a wash room, media room, subculture room and growth room
- high-efficiency particulate air (HEPA)-filtered positive air pressure systems for media, subculture and growth rooms
- growth rooms with appropriate light, temperature and humidity control
- subculture room fitted with ultraviolet (UV) germicidal lamps
- laminar flow cabinets for subculturing, which are serviced regularly
- laminar flow cabinets fitted with UV germicidal lamps
- a programme for periodic disinfection/fumigation of the facility
- use by staff of disposable/dedicated footwear or disinfection of footwear before entry
- appropriate hygienic practices for handling plant material (e.g. cutting *in vitro* plantlets with a sterile scalpel over a sterile disposable surface)
- a monitoring programme to check the level of air-borne contaminants in the subculture room and growth room
- an inspection and disposal procedure for contaminated potato micropropagative material.

[84] The presence and effectiveness of these attributes should be verified during the audits described in section 7 of the main text of this standard.

[85]
[86] **REQUIREMENTS FOR MINITUBER PRODUCTION FACILITIES**

[87] The requirements for minituber production facilities may include, as appropriate, depending on the presence of pests in the area and the results of PRA, the following:

[88] **Physical structure**

- double door entry with a change area for changing garments and donning protective overcoats and gloves, the change area to be provided with foot disinfecting pads and a washing facility for washing and disinfecting hands
- entry doors and all vents and openings covered with insect-proof screen with mesh appropriate to the local pests and pest vectors
- gaps between the external to internal environment to be sealed
- production isolated from soil (e.g. concrete floors or floors covered with a protective membrane)
- designated areas for washing and disinfection of containers, cleaning, grading, packing and storing of minitubers
- air filtration system

[89] **Environment controls**

- appropriate temperature, light and humidity controls
- misting for acclimatization of transplants

[90] **Crop management**

- regular pest and pest vector monitoring at specified intervals by use of appropriate methods (e.g. sticky insect traps)
- appropriate hygienic practices for handling plant material
- appropriate disposal procedures
- identification of production lots
- a suitable separation between lots

[91] **Growing media, fertilizer, water**

- use of soil-less growing medium
- fumigation/disinfestations/steam sterilization of the growing medium before planting
- transport and storage of growing medium under conditions preventing contamination
- use of deep-well spring water or appropriately treated public water supply
- appropriate treatment of water to eliminate pests where necessary
- use of inorganic fertilizer
- appropriate treatment of organic fertilizer to eliminate pests

[92] **Post-harvest handling**

- appropriate sampling of minitubers for post-harvest tuber testing for indicator pests (i.e. pests whose presence indicates that the pest free status of the protected environment has not been maintained)
- appropriate storage conditions
- grading and packing (if appropriate, according to a seed potato certification scheme)
- new containers used for packing minitubers
- containers for shipment adequate for preventing contamination by pests and pest vectors
- cleaning and disinfection of handling equipment and storage facilities.

[93] The presence and effectiveness of these attributes should be verified during the audits described in section 7 of the main text of this standard.

**PESTS THAT ARE NOT CONSISTENTLY EXCLUDED BY CONVENTIONAL
MICROPROPAGATION TECHNIQUES AND THAT ARE COMMONLY TESTED FOR**

	VIRUSES	ABBREVIATION	GENUS
[row1]	<i>Alfalfa mosaic virus</i>	AMV	<i>Alfamovirus</i>
[row2]	<i>Andean potato latent virus</i>	APLV	<i>Tymovirus</i>
[row3]	<i>Andean potato mottle virus</i>	APMoV	<i>Comovirus</i>
[row4]	<i>Arracacha virus B-oca strain</i>	AVB-O	<i>Nepovirus</i>
[row5]	<i>Beet curly top virus</i>	BCTV	<i>Curtovirus</i>
[row6]	<i>Belladonna mottle virus</i>	BeMV	<i>Tymovirus</i>
[row7]	<i>Cucumber mosaic virus</i>	CMV	<i>Cucumovirus</i>
[row8]	<i>Eggplant mottled dwarf virus</i>	EMDV	<i>Nucleorhabdovirus</i>
[row9]	<i>Impatiens necrotic spot virus</i>	INSV	<i>Tospovirus</i>
[row10]	<i>Potato aucuba mosaic virus</i>	PAMV	<i>Potexvirus</i>
[row11]	<i>Potato black ring spot virus</i>	PBRSV	<i>Nepovirus</i>
[row12]	<i>Potato latent virus</i>	PotLV	<i>Carlavirus</i>
[row13]	<i>Potato leaf roll virus</i>	PLRV	<i>Polerovirus</i>
[row14]	<i>Potato mop-top virus</i>	PMTV	<i>Pomovirus</i>
[row15]	<i>Potato rough dwarf virus</i>	PRDV	<i>Carlavirus</i>
[row16]	<i>Potato virus A</i>	PVA	<i>Potyvirus</i>
[row17]	<i>Potato virus M</i>	PVM	<i>Carlavirus</i>
[row18]	<i>Potato virus P</i>	PVP	<i>Carlavirus</i>
[row19]	<i>Potato virus S</i>	PVS	<i>Carlavirus</i>
[row20]	<i>Potato virus T</i>	PVT	<i>Trichovirus</i>
[row21]	<i>Potato virus U</i>	PVU	<i>Nepovirus</i>
[row22]	<i>Potato virus V</i>	PVV	<i>Potyvirus</i>
[row23]	<i>Potato virus X</i>	PVX	<i>Potexvirus</i>
[row24]	<i>Potato virus Y (all strains)</i>	PVY	<i>Potyvirus</i>
[row25]	<i>Potato yellow dwarf virus</i>	PYDV	<i>Nucleorhabdovirus</i>
[row26]	<i>Potato yellow mosaic virus</i>	PYMV	<i>Begomovirus</i>
[row27]	<i>Potato yellow vein virus</i>	PYVV	<i>Crinivirus</i>
[row28]	<i>Potato yellowing virus</i>	PYV	<i>Alfamovirus</i>
[row29]	<i>Solanum apical leaf curling virus</i>	SALCV	<i>Begomovirus</i>
[row30]	<i>Sowbane mosaic virus</i>	SoMV	<i>Sobemovirus</i>
[row31]	<i>Tobacco mosaic virus</i>	TMV	<i>Tobamovirus</i>
[row32]	<i>Tobacco necrosis virus</i>	TNV	<i>Necrovirus</i>
[row33]	<i>Tobacco rattle virus</i>	TRV	<i>Tobravirus</i>
[row34]	<i>Tobacco streak virus</i>	TSV	<i>Ilarvirus</i>
[row35]	<i>Tomato black ring virus</i>	TBRV	<i>Nepovirus</i>
[row36]	<i>Tomato chlorotic spot virus</i>	TCSV	<i>Tospovirus</i>
[row37]	<i>Tomato leaf curl New Delhi virus</i>	ToLCNDV	<i>Begomovirus</i>
[row38]	<i>Tomato mottle Taino virus</i>	ToMoTV	<i>Begomovirus</i>
[row39]	<i>Tomato mosaic virus</i>	ToMV	<i>Tobamovirus</i>
[row40]	<i>Tomato spotted wilt virus</i>	TSWV	<i>Tospovirus</i>
[row41]	<i>Tomato yellow leaf curl virus</i>	TYLCV	<i>Begomovirus</i>
[row42]	<i>Tomato yellow mosaic virus</i>	ToYMV	<i>Begomovirus</i>
[row43]	<i>Tomato yellow vein streak virus</i>	ToYVSV	<i>Geminivirus</i>
[row44]	<i>Wild potato mosaic virus</i>	WPMV	<i>Potyvirus</i>

[row46]	VIROIDS	ABBREVIATION	GENUS
[row47]	<i>Mexican papita viroid</i>	MPVd	<i>Pospiviroid</i>
[row48]	<i>Potato spindle tuber viroid</i>	PSTVd	<i>Pospiviroid</i>
[row49]	<i>Potato deforming mosaic</i> (Argentina)		
[row50]	Saq'O		
[row51]	BACTERIA		
[row52]	<i>Clavibacter michiganensis</i> subsp. <i>sepedonicus</i>		
[row53]	<i>Erwinia</i> species <i>E. carotovora</i> <i>E. atroseptica</i> <i>E. chrysanthemi</i>		
[row54]	<i>Ralstonia solanacearum</i>		
[row55]	PHYTOPLASMAS		
[row56]	e.g. purple top, stolbur		

[97]

[98]

**PESTS COMMONLY REQUIRED TO BE EXCLUDED FROM POTATO
MINITUBER PRODUCTION**

[99] In addition to pests listed in Appendix 1, many pests are commonly required to be excluded from certified minituber potato production either as quarantine pests or as regulated non-quarantine pests according to the pest status in the country concerned. Some examples are:

[100] **Bacteria**

- *Streptomyces scabies*

[101] **Fungi**

- *Angiosorus (Thecaphora) solani*
- *Fusarium solani*
- *Phytophthora infestans*
- *Polyscytalum pustulans*
- *Rhizoctonia solani*
- *Synchytrium endobioticum*
- *Verticillium dahliae* and *V. alboatrum*

[102] **Insects**

- *Phthorimaea operculella*
- *Premnotrypes* spp.
- *Tecia solanivora*

[103] **Nematodes**

- *Ditylenchus destructor*
- *Globodera pallida*
- *G. rostochiensis*
- *Meloidogyne* spp.

[104] **Protozoa**

- *Spongospora subterranean*