International Rules for Seed Testing 2027

Validated Seed Health Testing Methods



7-035: Detection of *Fusarium* species on cereal seeds

Including changes and editorial corrections adopted at the Ordinary General Meeting 2026 in Calgary, Canada

Effective from 1 January 2027

Validation reports

See References. Copies are available by e-mail from the ISTA Secretariat at ista.office@ista.ch.

Please send comments, suggestions or reports of problems relating to this method to the ISTA Seed Health Committee, c/o ISTA Secretariat.

Disclaimer

Whilst ISTA has taken care to ensure the accuracy of the methods and information described in this method description, ISTA shall not be liable for any loss or damage, etc. resulting from the use of this method.

Safety precautions

Ensure you are familiar with hazard data and take appropriate safety precautions, especially during weighing out of ingredients. It is assumed that persons carrying out this test are in a laboratory suitable for carrying out microbiological procedures and familiar with the principles of Good Laboratory Practice, Good Microbiological Practice, and aseptic techniques. Dispose of all waste materials in an appropriate way (e.g. autoclaving, disinfection) and in accordance with local health, environmental and safety regulations.

Note on the use of the translations

The electronic version of the International Rules for Seed Testing includes the English, French, German and Spanish versions. If there are any questions on interpretation of the ISTA Rules, the English version is the definitive version.

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7-035: Detection of *Fusarium* species on cereal seeds

Host: *Triticum aestivum* L.; *Hordeum vulgare* L.; *Avena sativa* L.

Pathogen(s):

- *Fusarium avenaceum* (Fries) Saccardo
- *Fusarium crookwellense* Burgess, Nelson & Toussoun
- *Fusarium culmorum* (W.G. Smith) Saccardo
- *Fusarium graminearum* Schwabe
- *Fusarium langsethiae* Torp & Nirenberg
- *Fusarium poae* (Peck) Wollenweber
- *Fusarium pseudograminearum* Aoki & O'Donnell
- *Fusarium sporotrichioides* Sherbakoff
- *Fusarium tricinctum* (Corda) Saccardo

Prepared by: ISTA Seed Health Committee

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Revision history

Version 1.0, 2027-01-01: New method

Background

Besides *Microdochium majus* and *M. nivale*, *Fusarium* head blight (FHB) complex is also caused by several *Fusarium* species and is considered one of the most important diseases of cereals worldwide. The disease may result in significant yield losses and poor seed quality. Several of these *Fusarium* species can produce toxic secondary metabolites (mycotoxins) (Desjardins, 2006) that can reduce the use of the grain for human and/or animal consumption. For example, the species *F. graminearum*, one of the most aggressive FHB pathogens and producer of the important mycotoxin deoxynivalenol (DON), was ranked number four in an international nomination of the top ten most economically important fungal pathogens (Dean *et al.*, 2012).

At the ISTA seed health workshop in Angers, France in 2010, participants commented that the ISTA method 7-022 for detecting *Microdochium* spp. is also suitable for detection of *Fusarium* spp. It was stated in the validation report for 7-022 that the method was appropriate for the generic detection of *Fusarium* species, with the addition of further steps to aid species identification.

Potato dextrose agar (PDA) and malt agar (MA) are suitable media to detect *Fusarium* species on cereal seed (Leslie and Summerell, 2006) and were used for the validation. Incubation at 20 ±2 °C will either be with near-ultraviolet (NUV) light, or in darkness followed by exposure to daylight or NUV light. However, the transfer of colonies to special low-nutrient media, e.g. spezieller nährstoffarmer agar (SNA) or carnation leaf-piece agar (CLA), would facilitate species identification. The low-nutrient media induce sporulation and reliably produce uniform conidia that are more representative of the species than those produced on PDA or MA. If plated on different media, *Fusarium* species can present notoriously different phenotypes. For identification, it is thus important to standardise the media used within the laboratory and ensure it is of a consistent make-up.

The ISTA Seed Health Committee decided to carry out a validation study for the detection of *Fusarium* spp. on cereal seeds, based on the ISTA 7-022 method for detection of *Microdochium* spp. on wheat (ISTA, 2020).

Nine species of *Fusarium* were tested using this method, as well as *M. majus* and *M. nivale*: *F. graminearum*, *F. culmorum*, *F. poae*, *F. langsethiae*, *F. avenaceum*, *F. crookwellense*, *F. pseudograminearum*, *F. sporotrichioides* and *F. tricinctum*.

Hazard group

Fusarium species have been categorised in hazard group 2 as cereal pathogens, due to their capacity to produce mycotoxins, and in hazard group 2 as human pathogens which can cause disease, especially in immunosuppressed individuals. These pathogens should be handled at containment level 2 and any procedures likely to cause airborne spores should be conducted within a microbiological safety cabinet. Please ensure you have carried out a risk assessment for handling these pathogens and consult the Health and Safety Executive (HSE) guidance (Biosafety and microbiological containment; www.hse.gov.uk/biosafety) for further information.

Treated seed

This method has not been validated for the detection of *Fusarium* on treated seed. (Definition of treatment: any process, physical, biological or chemical, to which a seed lot is subjected, including seed coatings. See 7.2.3.)

Sample size

The sample size (total number of seeds to be tested) and subsample size depend on the desired tolerance standard (maximum acceptable number of seeds infested) and detection limit (theoretical minimum number of pathogen propagules per seed which can be detected). The minimum recommended sample size should be 400 seeds.

Materials

Reference material: reference cultures or other appropriate material

Media: malt agar (MA) or potato dextrose agar (PDA) with streptomycin sulphate (for detection); carnation leaf-piece agar (CLA) or spezieller nährstoffarmer agar (SNA) (for species confirmation)

Autoclave

1 % sodium hypochlorite solution (NaOCl): for seed disinfection

Sterile distilled or deionised or water

Sterile or aseptic filter paper: for blotting seed dry

Plates: 90 mm sterile Petri dishes (one for a maximum of ten seeds)

Steriliser: microbead steriliser or methylated spirit burner for sterilisation of microscope tools

Forceps

Dissecting needles

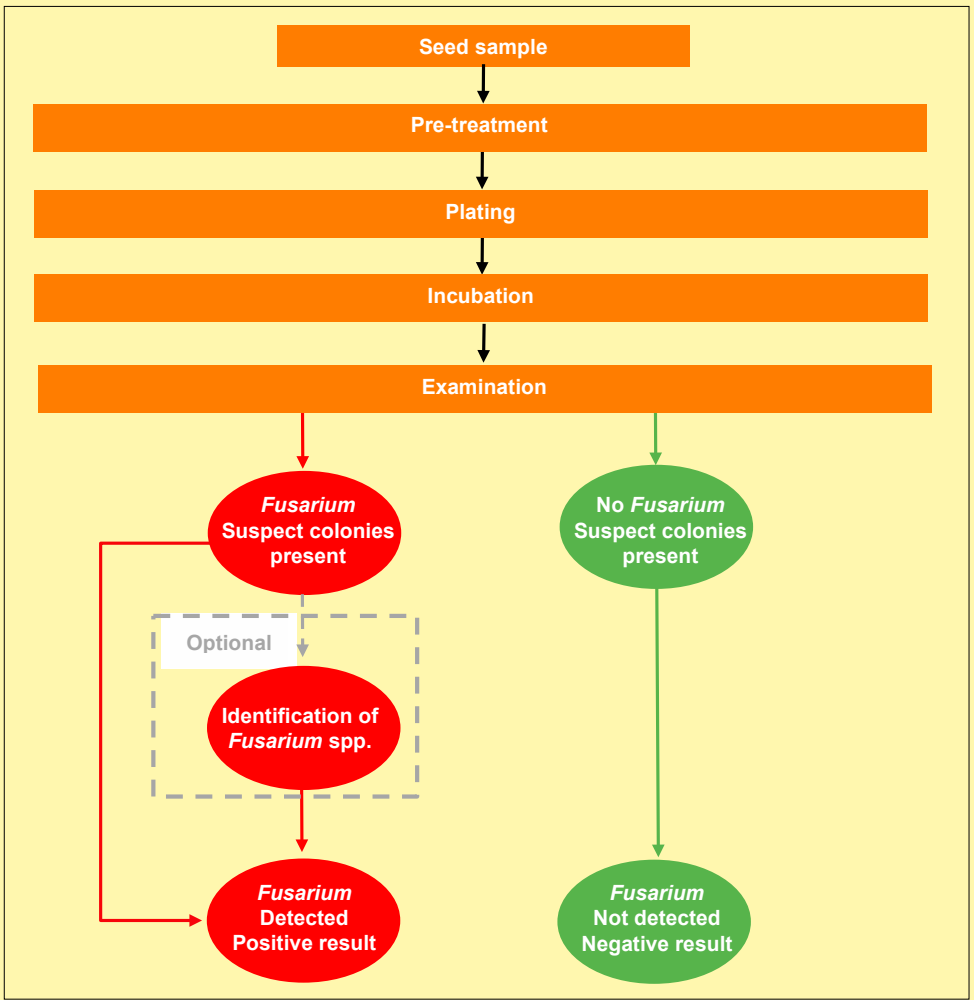
Microscope slides and coverslips

Incubator: operating at 20 ±2 °C darkness (incubation of samples)

Incubator: operating at 20 ±2 °C with 12 h NUV light 360 nm (after subculture on CLA and SNA)

Stereomicroscope: ×6.5–50 magnification

Compound microscope: ×100–400 magnification



Methods

Note: All the steps described here are important and should be followed as written. Critical control points are indicated by CCP. This method includes a procedure to detect *Fusarium* species, and descriptors to identify some *Fusarium* species. *Fusarium* reporting results can be expressed as genus, part of a complex or to species level (see 'Reporting results').

1. Detection method

1.1 Pretreatment: Immerse seeds in a 1 % sodium hypochlorite (NaOCl) solution for 10 min, then drain, rinse well in deionised or sterile distilled water and drain again. Dry the seeds on clean blotting paper.

1.2 Plating: Aseptically place a maximum of ten seeds, evenly spaced around the perimeter of the plate, onto the agar surface of each PDA or MA plate (CCP).

1.3 Positive control (reference material): Aseptically plate a reference culture corresponding to at least one of the *Fusarium* species, on the same medium as that used for the detection.

1.4 Incubation: Incubate plates for 7 d at 20 ±2 °C in the dark.

2. Examination: Examine the plates after 7 d of incubation.

2.1 Examine the plates by eye, looking at each colony arising from the seeds for cultures with a morphology matching a *Fusarium* species. If required, subculturing can be done onto CLA or SNA plates for an accurate *Fusarium* species identification (optional). Some isolates may be easily identified without further subculturing.

2.2 *Fusarium* species are very diverse in colour, shape and size; the main species found on cereals are described at the end of the method. The identity of colonies and conidia from sporodochia may be confirmed by compound microscope (×100–1000 magnification). Incubation can be extended under NUV at 360 nm for a few days to stimulate sporulation. When the identity of a colony remains uncertain, these colonies can be subcultured on CLA adjacent to the carnation leaf piece or on SNA + filter paper medium (see Fig. 1) with incubation under NUV.

Note: The principle morphological criteria that must be considered for the identification are:

- Presence or absence of microconidia
- Microconidia shape
- Type of conidiophores
- Phialide (conidiophore) type
- Presence or absence of macroconidia
- Macroconidia shape
- Presence or absence of chlamydospore
- Other structures: coiled sterile hyphae, pseudochlamydospores, swollen hyphae

The morphological criteria are described at the end of this Seed Health Method.

General methods

Reporting results: The result of a seed health test should indicate the scientific name of the pathogen detected and the test method used. When reported on an ISTA Certificate, results are entered under 'Other Determinations'.

The report must indicate the number of seeds tested.

In the case of a negative result (pathogen not detected), the results must be reported as 'not detected'. In the case of a positive result, the report must indicate the percentage of infected seeds.

Depending on whether it has been possible to identify the species, the results reported could be:

- *Fusarium* spp.
- *Fusarium* in a named complex following Crous *et al*. (2021), O'Donnell *et al*. (2022) (percentage for each complex). The complexes concerning the *Fusarium* defined in this method are described in Table 1.
- Individual *Fusarium* species (percentage for each identified species).
- A combination of the above three propositions.

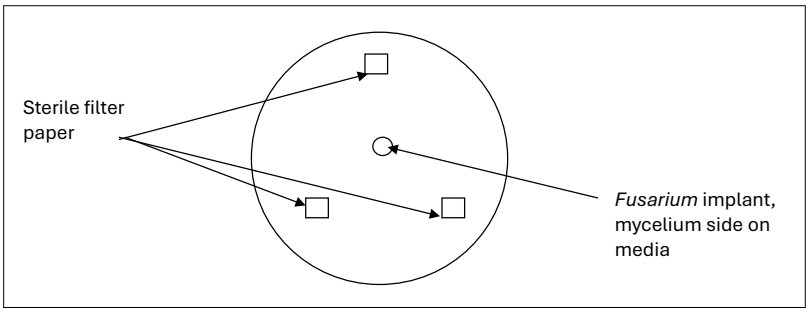


Figure 1. Subculture for identification of *Fusarium* on spezieller nährstoffarmer agar medium.

Quality assurance

Critical control points (CCP)

- Method section 1.2: Many saprophytic fungi present on cereals are fast growing in comparison to the target pathogens; there is a risk of the plates being unreadable if the seeds are too close.
- Preparation of PDA or MA plates: The source of agar may influence the results. The level of available nutrients may vary between manufacturers. Both PDA and MA can be bought as a powdered medium, or MA can be made up following the recipe below. Whenever a new batch of agar is used, a check on the quality should be made, using a reference lot with a known infection level, or a reference isolate and sustainability of isolate measured. Pay particular attention to the growth characteristics of reference isolates.

Media and solutions

Potato dextrose agar + streptomycin (CCP)

Potato dextrose agar: make according to specification of supplier
Distilled/deionised water: 1000 ml
Streptomycin sulphate*: 50–130 mg
*added after autoclaving

Use 50–130 mg of streptomycin sulphate, depending on the level of saprophytic bacterial contamination commonly encountered. Streptomycin sulphate can be dissolved in distilled/deionised water. Filter sterilisation is required.

Preparation

1. Weigh out ingredients into a suitable autoclavable container.
2. Add 1000 ml of distilled/deionised water.
3. Dissolve powdered PDA in the water by stirring.
4. Autoclave at 121 °C and 15 psi for 15 min.
5. Adjust to pH 5.6 ±0.2 pH units.
6. Allow agar to cool to approximately 50 °C and add streptomycin sulphate dissolved in water.
7. Pour 20–22 ml of molten agar into 90 mm Petri dishes and allow to solidify before use.

Storage

Prepared plates may be stored at 5 ±2 °C for up to 6 weeks.

Malt agar + streptomycin (CCP)

Agar: 20 g
Malt: 10 g
Distilled/deionised water: 1000 ml
Streptomycin sulphate*: 50–130 mg
*added after autoclaving

Use 50–130 mg of streptomycin sulphate, depending on the level of saprophytic bacterial contamination commonly encountered. Streptomycin sulphate can be dissolved in distilled/deionised water. Filter sterilisation is required.

Preparation

1. Weigh out the malt into a suitable autoclavable container.
2. Add 1000 ml of distilled/deionised water.
3. Add the agar and the remainder of the water, and dissolve completely before autoclaving.
4. Autoclave at 121 °C and 15 psi for 15 min.
5. Allow agar to cool to approximately 50 °C and add streptomycin sulphate dissolved in water.
6. Pour 18–20 ml of molten agar into 90 mm Petri dishes and allow to solidify before use.

If using ready-to-use 1 % malt agar, prepare according to specifications of supplier.

Storage

Prepared plates may be stored at 5 ±2 °C for up to 6 weeks.

Spezieller nährstoffarmer agar + filter paper

Agar: 15 g
KH_2PO_4: 1.0 g
KNO_3: 1.0 g
$MgSO_4 \times 7H_2O$: 0.5 g
KCl: 0.5 g
Glucose: 0.2 g
Saccharose: 0.2 g
Distilled/deionised water: to 1000 ml
Sterile or aseptic filter paper: around 1 cm² each

Preparation

1. Weigh out agar and other compounds into a suitable autoclavable container.
2. Add 1000 ml of distilled/deionised water.
3. Completely dissolve ingredients in water by stirring.
4. Autoclave at 121 °C and 15 psi for 15 min.
5. Allow to cool to approximately 50 °C.
6. Pour 20 ml of molten agar into 90 mm Petri dishes and allow to solidify before use.
7. Aseptically place three squares of filter paper onto the surface of each media.

Storage

Prepared plates may be stored at 5 ±2 °C for up to 6 weeks.

Carnation leaf-piece agar

Agar: 20 g
Distilled/deionised water: 1000 ml
Carnation leaf pieces: 5–8 mm^2, dried at 70 °C for 3–4 h, and gamma irradiated at 2.5 megarads (CCP); up to ten pieces are placed onto a 90 mm water agar plate

Preparation

1. Weigh out agar into a suitable autoclavable container.
2. Add 1000 ml of distilled/deionised water.
3. Completely dissolve ingredients in water by stirring.
4. Autoclave at 121 °C and 15 psi for 15 min.
5. Allow to cool to approximately 50 °C.
6. Pour 20 ml of molten agar into 90 mm Petri dishes and allow to solidify before use.
7. Aseptically place ten pieces (spaced apart) of carnation leaves onto the surface of each plate.

Storage

Prepared plates may be stored at 5 ±2 °C for up to 6 weeks.

Sodium hypochlorite solution

Sodium hypochlorite for pretreatment of seed can be prepared from commercial bleach diluted to 1 % available chlorine. The concentration of chlorine in commercial bleach varies considerably and declines with storage. Use the formula:

$$V_{stock} = V_{final} \times C_{final} / C_{stock}$$

(where V = volume and C = % available chlorine) to calculate the volume of commercial bleach stock solution required to prepare sodium hypochlorite solutions for use in seed pretreatment.

To prepare a 1 l solution of sodium hypochlorite containing 1 % chlorine from a stock of commercial bleach containing 12 % available chlorine:

$$V_{stock} = 1 \times 1/12 = 0.083$$

Thus add 83 ml of the 12 % stock to 917 ml water.

The percentage of active chlorine decreases rapidly in solution so NaClO 1 % solution must be stored in the dark and used within 3 days of preparation. It is possible to check chlorine concentration with chlorine strip tests.

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Nelson, P.E., Toussoun, T.A. and Marasas, W.F.O. (1983). Fusarium *Species: An Illustrated Manual for Identification*. Pennsylvania State University Press, USA. 183 pp.

O'Donnell, K., Whitaker, B.K., Laraba, I., Proctor, R.H., Brown, D.W., Broders, K. *et al*. (2022). DNA sequence-based identification of *Fusarium*: a work in progress. *Plant Disease*, **106**(6), 1597–1609.

Validation references

ISTA (2025). Method validation reports on Rules proposals for the *International Rules for Seed Testing* 2026 Edition. International Seed Testing Association, Wallisellen, Switzerland.

Morphological criteria of main *Fusarium* on cereals

The morphological criteria listed here are based on descriptions from literature (see 'Morphology bibliography') and from observations obtained during the performance study of the method in analytical specificity on a collection of target isolates. The media used, the components of the media and incubation conditions (darkness/NUV light) can lead to slight differences in morphological appearance. Main criteria are described and are exemplified in the images of different species.

The species described here are based on Index Fungorum (www.speciesfungorum.org/Names/Names.asp). When other species names are described, the reference is given in the text.

Table 1. Species included in the *Fusarium* complexes

Species	*Fusarium* complex
F. crookwellense Burgess, Nelson & Toussoun	*F. sambucinum* complex
F. culmorum (W.G. Smith) Saccardo	
F. graminearum Schwabe	
F. langsethiae Torp & Nirenberg	
F. poae (Peck) Wollenweber	
F. pseudograminearum Aoki & O'Donnell	
F. sporotrichioides Sherbakoff	
F. avenaceum (Fries) Saccardo	*F. tricinctum* complex
F. tricinctum (Corda) Saccardo	

Summary of morphological criteria

Fusarium avenaceum (Fries) Saccardo
(see Fig. 2)

On malt agar: mycelium is abundant and aerial, yellow to pink coloured, sometimes creamy white; sporodochia are orange, concentrated in centre of colony

On potato dextrose agar: growth can vary from slow to somewhat rapid, aerial mycelium is dense and white but frequently varies in colour from yellow/tan to reddish-brown; undersurface colouration varies from tan to carmine red to dark brown; orange sporodochia may form on colonies originating from seed, depending on growth conditions; sporodochia quite often form in centre of colony on pure cultures

Conidiophores: unbranched and branched monophialides

Macroconidia: very long, slender and thin walled with foot-shaped basal cell and an elongated apical cell that may be bent

Microconidia: [cigar-shaped] are rare; mixed sizes of conidia (micro- and macro-) are observed from sporodochia on isolates on PDA, but on CLA only macroconidia true to type are observed

Chlamydospores: absent

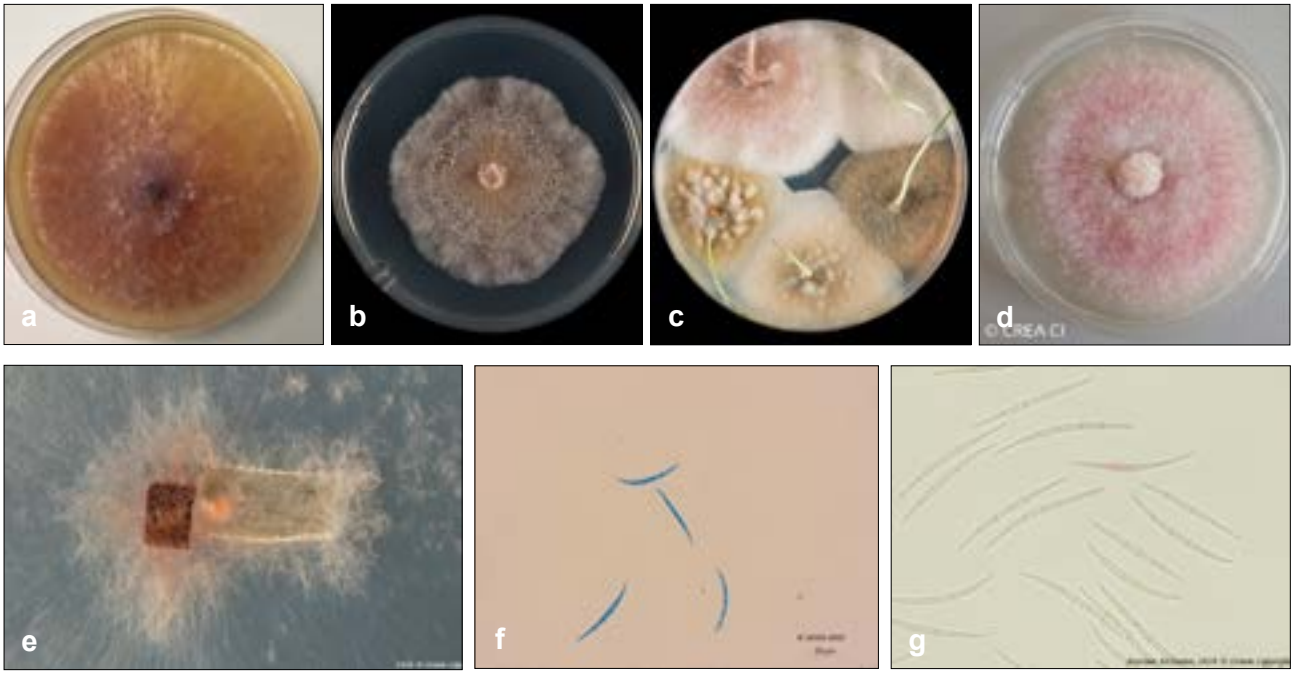


Figure 2. *Fusarium avenaceum*: **a** malt agar (MA) in darkness for 14 d; **b** potato dextrose agar (PDA) (Oxoid) with near-ultraviolet (NUV) light for 5 d; **c** PDA (Oxoid) after 7 d growth on seed (top left colony); **d** PDA (Difco) in darkness for 7 d; **e** formation of orange sporodochia containing macroconidia on carnation leaf-piece agar (CLA) after incubation under NUV light; **f** macroconidia stained with methyl blue (×200); **g** macroconidia unstained from CLA (×400).

Fusarium graminearum Schwabe
Fusarium pseudograminearum Aoki & O'Donnell
(see Fig. 3)

Note: As *F. graminearum* and *F. pseudograminearum* share common morphological criteria, they cannot be distinguished visually on plates.

On malt agar: mycelium is abundant and aerial, pink coloured and white to yellow on aerial part of mycelium; sporodochia are orange and concentrated in centre of colony

On potato dextrose agar: growth is usually rapid (e.g. Petri dishes filled within 4 d on pure culture) but can be variable, with dense aerial mycelium and frequently yellow to tan with margins white to carmine red; undersurface usually carmine red; red-brown to orange sporodochia, if present, are sparse in dark; sporodochia often appear in less than a week when under near-ultraviolet light

Conidiophores: unbranched and branched monophialides

Macroconidia: often present, distinctly septate, thick walled, straight to moderately sickle-shaped; ventral surface is almost straight and dorsal surface smoothly arched; basal cell is distinctly foot-shaped; apical cell curved, cone-shaped like a beak

Microconidia: absent

Chlamydospores: rare, formed in macroconidia or mycelium

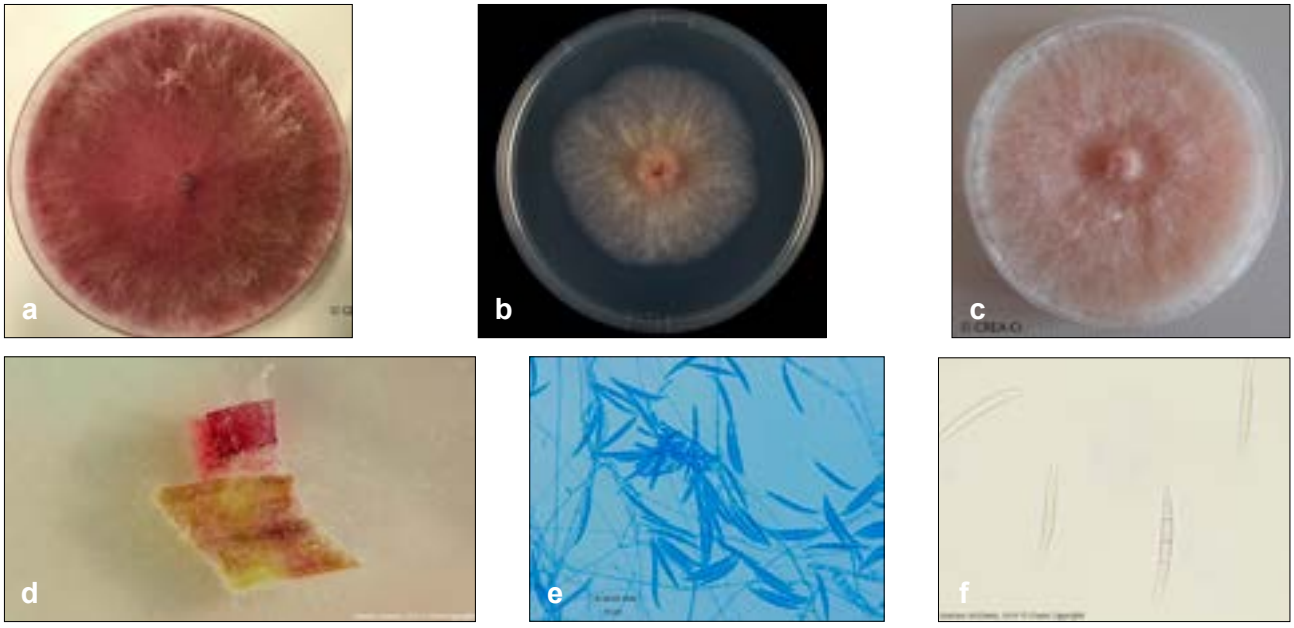


Figure 3. *Fusarium graminearum*: **a** malt agar (MA) in darkness for 14 d; **b** potato dextrose agar (PDA) (Oxoid) in darkness; **c** PDA (Difco) in darkness for 7 d; **d** *F. graminearum* on carnation leaf-piece agar (CLA); **e** macroconidia with methyl blue stain (×200); **f** macroconidia unstained from CLA (×400).

Fusarium culmorum (W.G. Smith) Saccardo
(see Fig. 4)

On malt agar: mycelium is short, pink to carmine red; sporodochia form on older cultures and are orange to red-brown in colour

On potato dextrose agar: growth is rapid, with dense aerial mycelium, generally white but often yellow to tan on base; undersurface is carmine red; orange to red-brown sporodochia appear readily

Conidiophores: unbranched and branched monophialides

Macroconidia: stout, distinctly septate, thick walled and have straight to curved ventral and dorsal surfaces; basal cell is usually distinctly round and can occasionally be foot-shaped to slightly notched

Microconidia: absent

Chlamydospores: generally form abundantly and quickly; may occur singly, in chains or in clumps

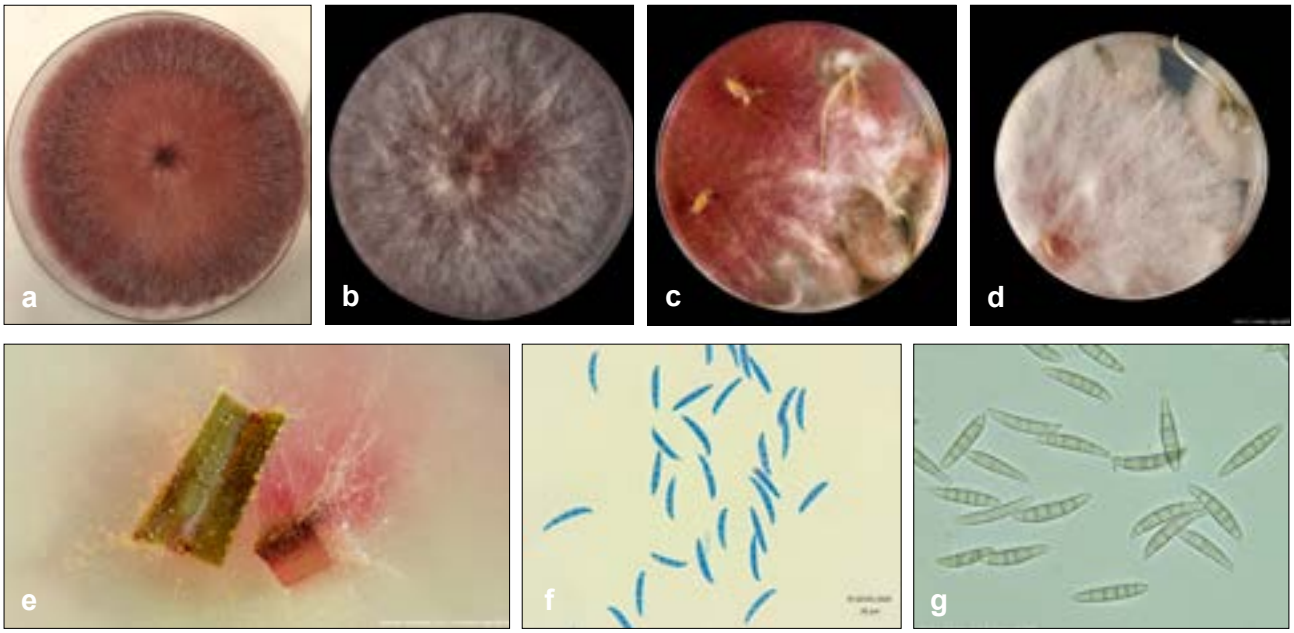


Figure 4. *Fusarium culmorum*: **a** malt agar (MA) in darkness for 14 d; **b** potato dextrose agar (PDA) (Oxoid) in darkness; **c** high sporulating isolate PDA (Oxoid) (on left), 7 d in darkness; **d** low sporulating isolate PDA (Oxoid) (on left), 7 d in darkness; **e** *F. culmorum* on carnation leaf-piece agar (CLA) with orange sporodochia; **f** macroconidia with methyl blue stain (×200); **g** macroconidia unstained from CLA (×400).

Fusarium crookwellense Burgess, Nelson & Toussoun
Fusarium cerealis (ref)
(see Fig. 5)

On malt agar: mycelium is abundant and aerial, white to pink, sometimes yellow; sporodochia are orange to red-brown
On potato dextrose agar: growth is rapid, with dense aerial mycelium, white in colour and then tan; undersurface is carmine red; orange to red-brown sporodochia generally appear early in centre of culture and later in other areas of culture
Conidiophores: unbranched and branched monophialides
Macroconidia: strongly septate, thick walled and unequally curved, with ventral surface less curved than dorsal surface, which is strongly arched; basal cell is distinctly foot-shaped; apical cell is distinctly curved and tapers to a narrow tip
Microconidia: absent
Chlamydospores: present and are formed in hyphae and macroconidia

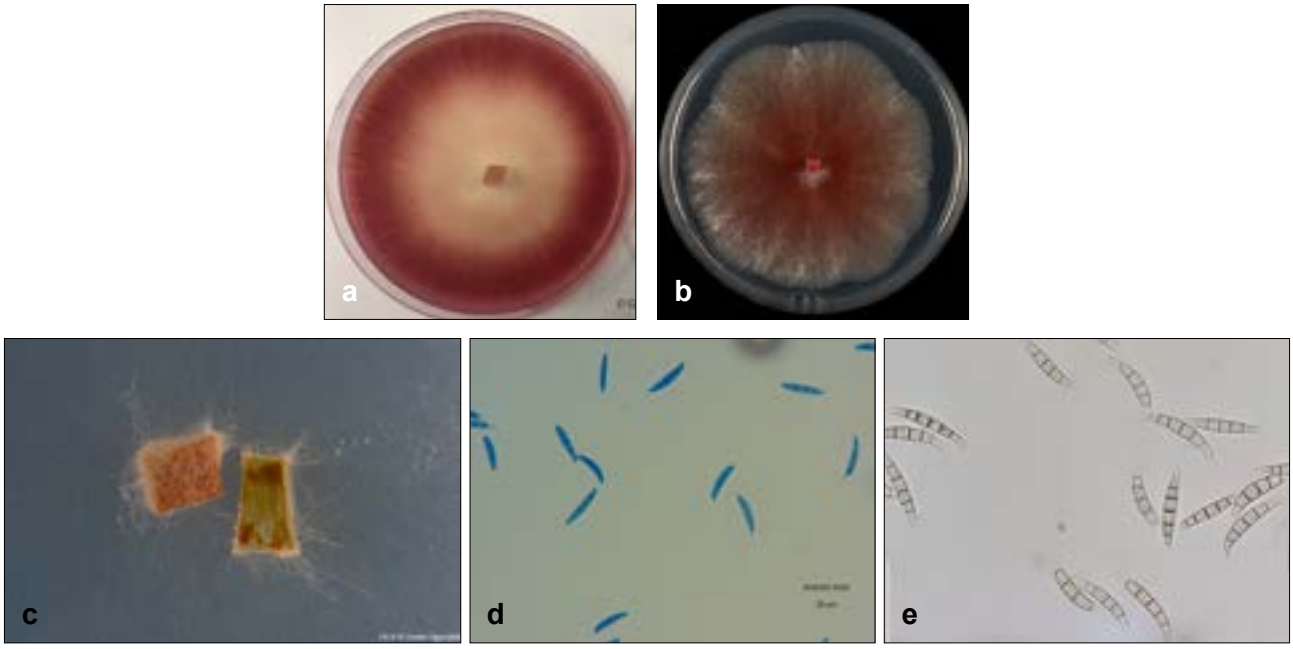


Figure 5. *Fusarium crookwellense*: **a** malt agar (MA) in darkness for 14 d; **b** potato dextrose agar (PDA) (Oxoid) in darkness for 7 d; **c** *F. crookwellense* on carnation leaf-piece agar (CLA) with dark orange sporodochia containing macroconidia forming readily; **d** macroconidia with methyl blue stain (×200); **e** macroconidia unstained (×400) from sporodochia on CLA.

Fusarium langsethiae Torp & Nirenberg

(see Fig. 6)

On malt agar: mycelium is short, white to yellow or pale orange; sporodochia are rare

On potato dextrose agar: growth is not very rapid; usually white powdery mycelium; undersurface is often white but can vary with several colours (yellow, pink, purple); very little aerial mycelium, variation can occur; globose microconidia are formed in abundance in powdery mycelium

Conidiophores: unbranched and branched monophialides and polyphialides

Macroconidia: absent

Microconidia: abundant, globose, in clumps

Chlamydospores: absent

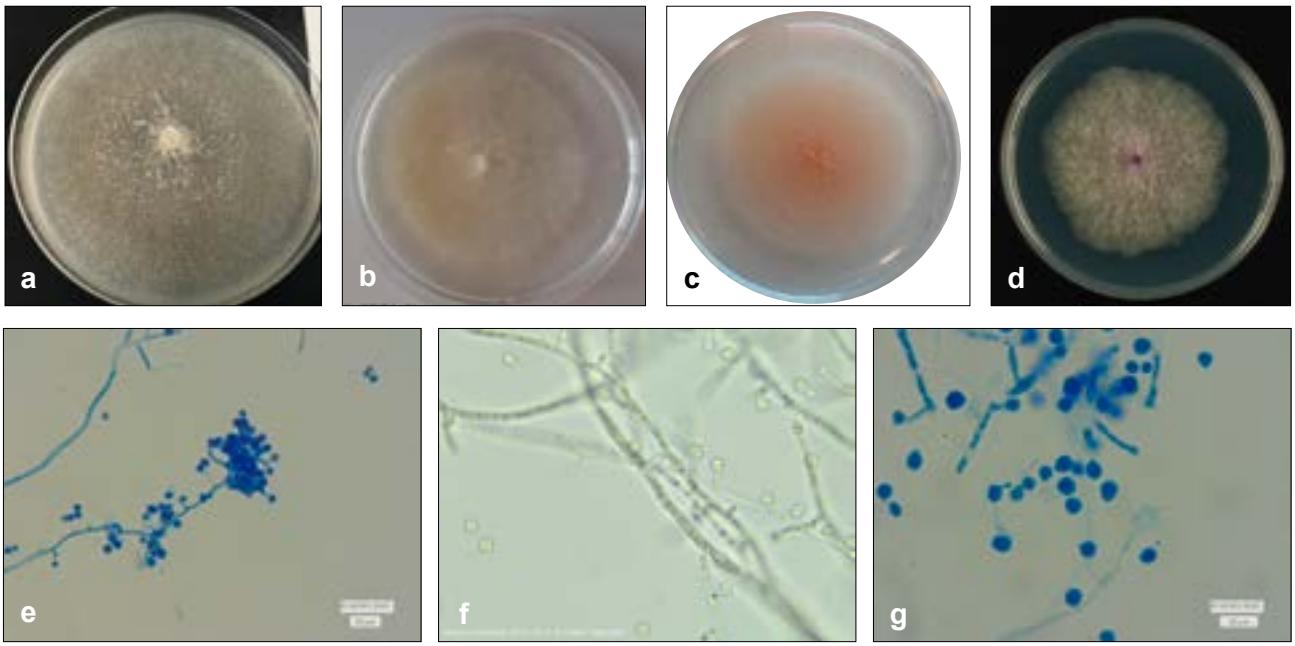


Figure 6. *Fusarium langsethiae*: **a** malt agar (MA) in darkness for 17 d; **b** potato dextrose agar (PDA) (Difco); **c** PDA (Difco) in darkness for 7 d; **d** PDA (Oxoid) in darkness for 7 d; **e** microconidia with methyl blue stain (×200); **f** microconidia unstained (×400); **g** microconidia with methyl blue stain (×1000).

Fusarium poae (Peck) Wollenweber
(see Fig. 7)

Note: Colonies have a distinct smell of apples.

On malt agar: mycelium is dense, aerial, white to pink; sporodochia are rare
On potato dextrose agar: growth is rapid, with dense aerial, cotton-like mycelium that is white, yellow to pink in colour; spores are readily formed in mycelium; undersurface is usually carmine red; sporodochia are rare
Conidiophores: unbranched and branched monophialides; microconidiophores are short and fat, almost globose and quite distinctive
Macroconidia: generally rare, typically sickle-shaped, 3–5 septate and have a foot-shaped basal cell
Microconidia: abundant, globose or oval in shape (napiform), 0–1 septate, and often have distinct papilla
Chlamydospores: occur infrequently and may be in clumps or chains

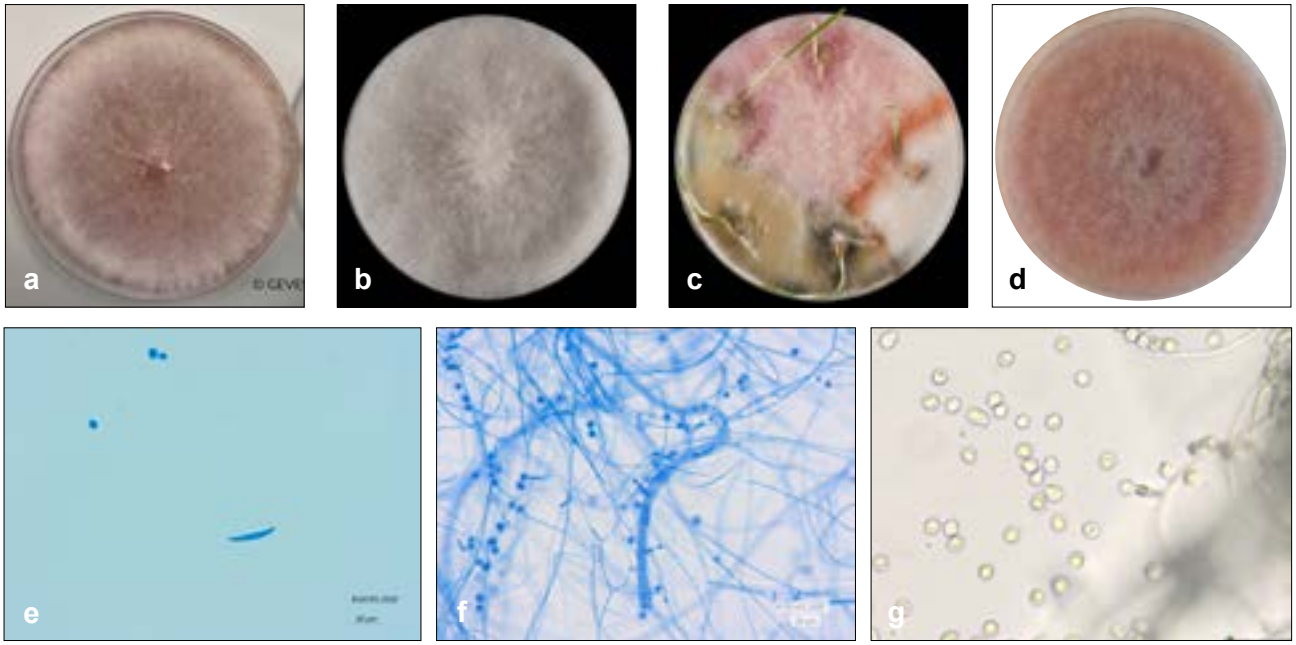


Figure 7. *Fusarium poae*: **a** malt agar (MA) in darkness for 14 d; **b** potato dextrose agar (PDA) (Oxoid) after 7 d in darkness; **c** PDA (Oxoid) on seed sample after 7 d in darkness, colony at top; **d** PDA (Difco) darkness for 7 d; **e** macroconidia with methyl blue stain (×400); **f** microconidia with methyl blue stain (×200); **g** microconidia unstained (×400).

Fusarium tricinctum (Corda) Saccardo

(see Fig. 8)

On malt agar: mycelium is short, white to dark pink, sometimes orange; sporodochia only appear on old cultures
On potato dextrose agar: aerial mycelium is dense and white to yellow; undersurface is carmine red; sporodochia appear as culture ages
Conidiophores: unbranched and branched monophialides
Macroconidia: abundant and sickle-shaped; basal cell is distinctly foot-shaped or notched
Microconidia: abundant and are lemon- to pear-shaped or spindle-shaped, 0–1 septate, and often have papilla at base; often appear in false heads like a cluster of grapes in arial mycelium
Chlamydospores: can be formed by some isolates, but form very slowly; if present, formed singly or in chains

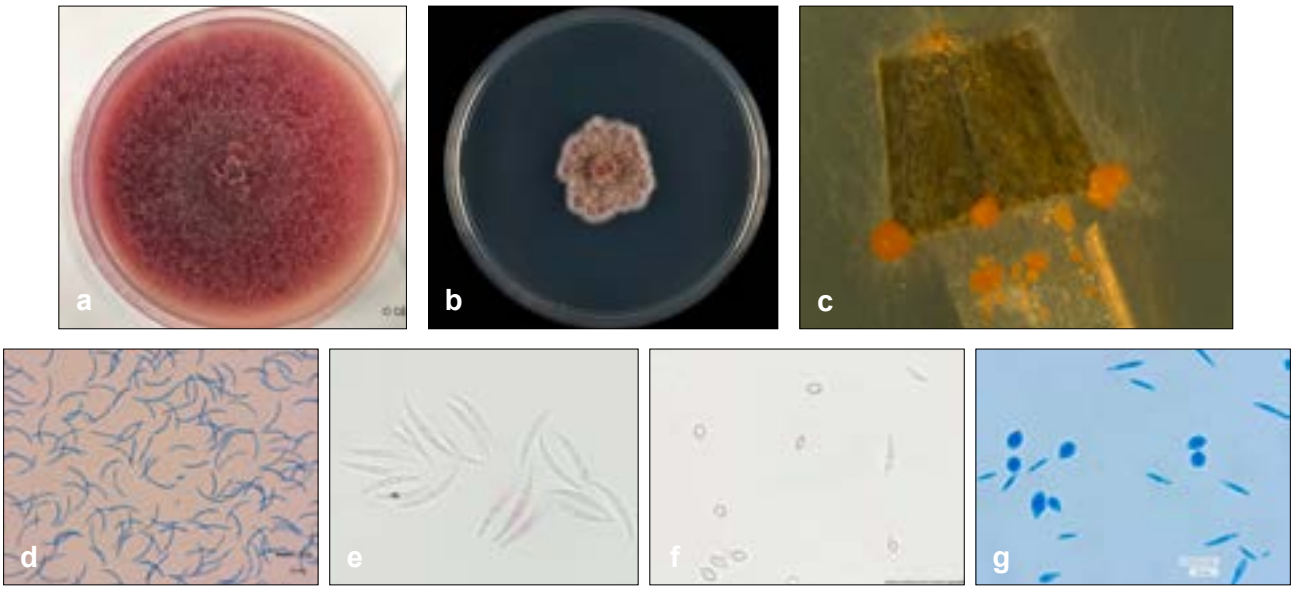


Figure 8. *Fusarium tricinctum*: **a** malt agar (MA) in darkness for 17 d; **b** potato dextrose agar (PDA) (Oxoid) darkness after 7 d; **c** orange sporodochia on carnation leaf-piece agar (CLA); **d** macroconidia with methyl blue stain (×400); **e** macroconidia unstained from CLA (×200); **f** juvenile macroconidia and microconidia (×400); **g** juvenile macroconidia and microconidia with methyl blue stain (×1000).

Fusarium sporotrichioides Sherbakoff

(see Fig. 9)

On malt agar: mycelium is aerial, white to pink, sometimes orange; sporodochia only appear on old cultures
On potato dextrose agar: growth is rapid and aerial mycelium is dense and white to yellow; undersurface is carmine red; sporodochia appear as culture ages
Conidiophores: unbranched and branched monophialides and polyphialides
Macroconidia: abundant, sickle-shaped, 3–5 septate; basal cell is not distinctly foot-shaped or notched
Microconidia: abundant and are oval to pear-shaped or spindle-shaped, 0–1 septate, often with papilla at base
Chlamydospores: present and abundant, formed singly, in chains or in clumps

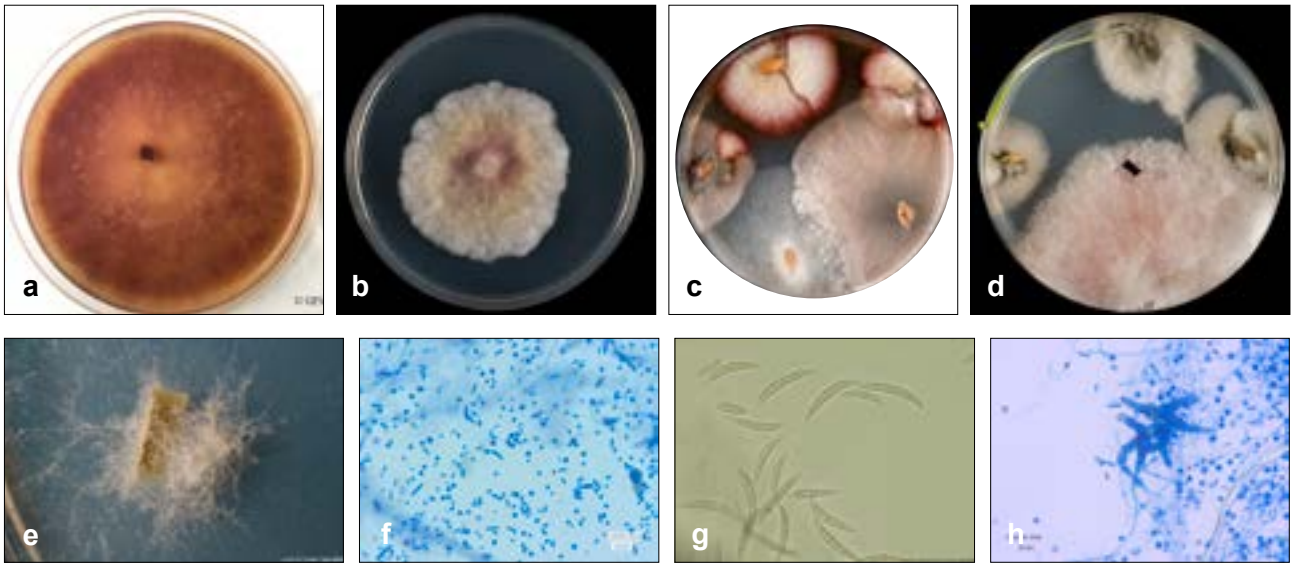


Figure 9. *Fusarium sporotrichioides*: **a** malt agar (MA) in darkness for 21 d; **b** potato dextrose agar (PDA) (Oxoid) after 7 d in darkness; **c** PDA (Oxoid) on seed sample (bottom left) at 7 d; **d** PDA (Oxoid) (bottom colony) on seed sample after 7 d; **e** isolate on carnation leaf-piece agar (CLA); **f** microconidia with methyl blue stain (x200); **g** macroconidia unstained from CLA (x400); **h** chlamydospores with methyl blue stain (x400).

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