



Assured Produce

Crop Specific Protocol

WATERCRESS

(CROP ID: 19)



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Acknowledgements

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Preface

This crop specific protocol has been written to complement and avoid duplicating the generic principles of the scheme and appendices.

It is advisable to read the Assured Produce Generic Crop Protocol Standards and the Assured Produce Generic Protocol Guidance Notes (referred to in this document as the Generic Standards and Generic Guidance Notes) first before reading this crop specific protocol.

This protocol is designed to stimulate thought in the mind of the reader.

This crop specific protocol contains crop specific parameters and guidance, where applicable, for the requirements stated in the Generic Standards.

All statements in this protocol containing the words "**must**" (in bold type) will be verified during the Assured Produce assessment and their compliance will form a part of the certification/approval decision. The score required for these "**must**" control points can be found on the final page of this document and in the checklists produced by Assured Produce licensed certification bodies.

Disclaimer and trade mark acknowledgement

Although every effort has been made to ensure accuracy, Assured Produce does not accept any responsibility for errors and omissions.

Trade names are only used in this protocol where use of that specific product is essential. All such products are annotated[®] and all trademark rights are hereby acknowledged.

Notes:

There may be other withdrawals or revocations. Products containing substances which have been revoked are shown on the PSD website (<http://www.pesticides.gov.uk>). Growers should check with their advisers, manufacturers, the Assured Produce website 'Newsflashes', the PSD website (www.pesticides.gov.uk)

Growers should comply with the 'Use up by' dates for all pesticide products. Growers should also be aware of and comply with changes on new product labels.

There may be changes for the following reasons:

- At re-registration stage after Annex 1 listing there may be: reductions of dose rates; changes in timings and/or number of applications for some products.

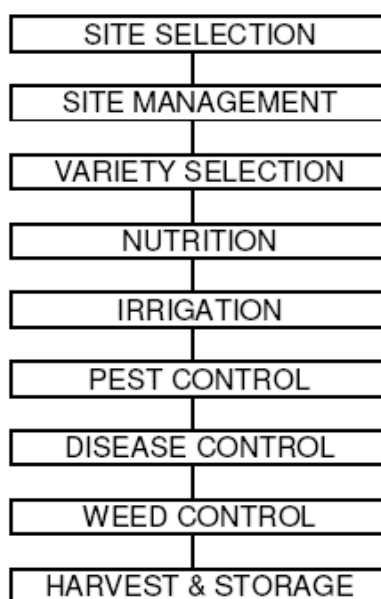
In the following Appendices products and use by dates are only listed for SOLAs, and in some cases new product MAPP numbers may not be available yet.

Any new standards have been prefixed in the text with (NEW)

1 General introduction

Following a systematic approach will help growers to identify and manage the risks involved in crop production. This protocol is based on a typical crop production process. Using a flowchart approach, food safety, Health & Safety, environmental and quality hazards are identified. Appropriate controls may then be established to minimise risk. Food safety and Health & Safety issues always take precedence over quality and environmental controls.

The flow chart is structured as shown below. Note that the sectional layout of both this protocol and the crop specific protocols follow the same structure.



The contents of each crop specific protocol are reviewed annually by informed farmers and growers, food technologists, scientists, the relevant fresh produce association, processors and agronomic consultants. Updated editions are issued prior to the cropping season.

The review process considers both new developments and all relevant technology which has emerged throughout the course of the previous year and which have been found to be both workable by the grower and beneficial to the environment. As one aim of the Scheme is to transfer such information and technologies to growers, attention is drawn to those features of specific relevance to ICM by using *italic* script. In order that growers may be confident that they are working to a current document, each protocol is dated and numbered.

1.1 Crop production

Almost all UK production is by members of the NFU Watercress Association, membership of which requires compliance with a code of practice that seeks to ensure high standards of hygiene for the product and the protection of the environment.

Commercial UK Watercress production takes place in levelled production areas known as cropping beds. Since water is subsequently discharged to rivers, any inappropriate actions in cropping beds can have immediate effects on the aquatic environment. The use of any pesticide by Watercress growers is therefore not only subject to statutory regulation by DEFRA, but also by the Environment Agency by means of discharge consents. In consequence, very few pesticides may be used in Watercress production, and then only in very small quantities and under tightly constrained conditions.

There are two systems of production commonly in operation, traditional and intensive. Under traditional management, plants crop throughout the autumn, most of the winter and in the spring, but not during the summer when they run to seed. Under intensive management the plants are removed before they are old enough to run to seed. Beds are then replanted with seedlings, produced in propagation units. This enables production throughout the year except when frost is very severe. Both the growing medium and the water used for propagation and for production beds must be tested for microbial contamination, including *E. coli*, at appropriate intervals.

Growers should have regard to the Generic Protocol and its supporting Guidance Notes. Since this crop is grown in water, additional precautions to help ensure that production conditions are hygienic are needed. Examples of precautions needed include:

- watercress must be grown in flowing water of high microbial quality.
- the water used must be protected to avoid or minimise the risk of contamination.
- water carriers and production beds must be protected from the intrusion of livestock.

2 Planning and records

See Generic Standards and/or Generic Guidance Notes.

3 Site selection

See Generic Standards and/or Generic Guidance Notes.

4 Site management

See Generic Standards and/or Generic Guidance Notes.

5 Variety selection

See Generic Standards and/or Generic Guidance Notes.

6 Nutrition

Any applications of nitrogen, phosphate, potash or magnesium must be applied in conjunction with crop requirements, and with strict regard to the terms of Environment Agency discharge consents.

7 Irrigation

See Generic Standards and/or Generic Guidance Notes.

8 Crop protection

8.1 The basic approach to crop protection

See Generic Standards and/or Generic Guidance Notes.

8.2 Plant protection product choice

Approved uses not included on the product label

In some circumstances product labels do not include all of the approved uses and growers and advisers wishing to check the approval notice of a particular product should note that this information is available from

www.pesticides.gov.uk/psd_databases.asp

A search on the database for a product name should yield a results page. A click on the product name should link to a summary of the approval information. At the bottom of the summary are links to available notices which will give the statutory conditions of use.

In the case of products with older approval an electronic approval may not be available. In these cases growers should contact the PSD Information Services Branch for details of the approved conditions of use.

Contact details are: p.s.d.information@psd.defra.gsi.gov.uk tel. 01904 455 775

Application

It is important to make certain that when pesticides are used, they are used precisely and in the correct conditions. Ensure that the operators applying these products are trained not only in application techniques but also have an understanding of the mode of action of the product and the optimum conditions required for the efficacy of that product.

There are no products with label recommendation for use on Watercress. Therefore all the products listed in this protocol have specific off-label approval. (See Appendix 5)

Manufacturers list on their label compatible mixtures with other pesticides. These are referred to as approved tank mixtures. However, no pesticides approved for use on Watercress are also approved in a tank mix on this crop.

8.3 Advice on the use of pesticides

See Generic Standards and/or Generic Guidance Notes.

8.4 Application of pesticides

It is important that application machinery is calibrated correctly. Nozzles should be inspected regularly and replaced where necessary, especially when a high proportion of wettable powders are being used.

Great care should be exercised in when washing out spray tanks. Thorough washing procedures will obviate both contamination and damage to the crop.

8.5 Records of application

See Generic Standards and/or Generic Guidance Notes.

8.6 Protective clothing/equipment

See Generic Standards and/or Generic Guidance Notes.

8.7 Pesticide storage

See Generic Standards and/or Generic Guidance Notes.

8.8 Empty pesticide containers

See Generic Standards and/or Generic Guidance Notes.

8.9 Pesticide residues in fresh produce

See Generic Standards and/or Generic Guidance Notes.

See Generic Protocol Guidance Notes 8.9 for further background and generic advice .

Assured produce is aware that a key area in the production of fresh produce which requires continued attention by growers and their advisers is that of keeping pesticide residues to a minimum. The issue is not just one of meeting the MRL trading standard but ensuring that any individual or multi residues are kept as low as possible below this level.

The key targets are:

- **Optimising late application of fungicides and insecticides to the edible part of the crop**
- **Optimising the use of post harvest treatments**
- **Ensuring minimum harvest intervals are followed**
- **Ensuring that application equipment is applying products correctly**

Currently there are no residue issues associated with this crop but the awareness needs to be maintained for any future issues.

8.9.1 Residue testing

Routine residue testing must be performed and target sampling for pesticides is the most cost-effective method. Sampling should be undertaken according to the guidelines set out by the Fresh Produce Consortium.

8.9.2 Pesticide residue testing traceability

See Generic Standards and/or Generic Guidance Notes.

8.9.3 Action plan

See Generic Standards and/or Generic Guidance Notes.

8.9.4 Harvesting intervals

The harvest interval is the time between spraying and harvest. Growers must strictly adhere to the stated intervals in the relevant 'Notice of Approval' documents.

It is most important that a grower establishes a visual procedure to help identify harvesting intervals within the crop. Some growers prefer coloured markers; others use labels to indicate when the crop is clear of the harvest interval. As clerical records may not be seen by everyone involved with the crop, the establishment of a visual record, (in addition to written records), makes everyone involved with the crop aware of the harvest intervals and avoids costly mistakes.

8.10 Pest, disease and weed control

8.10.1 Pest control

8.10.1.1 Integrated pest management (IPM)

IPM involves the production of quality crops with the minimum use of pesticides. To achieve this aim, it is important to monitor crops carefully at every stage of production in order to assess the need for crop protection products, whilst at the same time selecting products which will do least harm to the environment if there is more than one product to choose from. In order to achieve these aims, those responsible for monitoring crops must have a thorough knowledge of crop protection, especially of beneficial insects and the need to protect wildlife.

As Watercress is grown under a variety of circumstances it is impossible to lay down absolute guide-lines as these will vary with growing techniques and in particular, with geographic locations. Some growers have greater pest and disease pressure than others. An awareness of the prevailing conditions is required. This incorporates not only the status of pests or disease already present, but also encompasses other factors such as pest, disease and meteorological forecasts.

8.10.1.2 Flea beetles (*Phyllotreta* spp.)

These beetles hibernate in plant debris and emerge in spring to feed on cruciferous plants, mate and lay eggs in soil. They may attack Watercress at this time. The subsequent larvae feed on various plant roots and are therefore not a pest of Watercress. The new generation adults appear in late summer when they may again feed on Watercress before migrating back to hedgerows, etc to prepare for hibernation. There are therefore, two peaks of infestation, usually in April and July.

The beetles can cause significant damage by eating holes in the leaves, affecting the crop-acceptability to consumers. Control measures need to be applied as soon as crop damage is seen and/or when monitoring systems indicate imminent invasion and damage.

Cultural control: *Beetles can be removed by flooding the cropping beds for about 2 hours. This causes the beetles to float off, and they can be skimmed off the surface of the water.*

Chemical control: No products are currently approved.

8.10.1.3 Mustard beetle (*Phaedon cochleariae*)

Like flea beetles, mustard beetle infests a range of cruciferous plants but particularly mustard. Beetles that have overwintered in plant debris feed and lay eggs in leaf tissue throughout early summer. The larvae then feed on the leaves, subsequently pupating in the soil to produce a second generation that lays more eggs in late summer. These overlapping generations can lead to an almost continuous infestation of Watercress by adult beetles throughout the summer. Eggs are not laid on Watercress so damage is limited to the leaf and contamination by adult beetles.

Cultural control: *Beetles can be removed by flooding the cropping beds for about 2 hours to float them off, and then skimming the beetles off the surface of the water.*

Chemical control: No products are currently approved.

8.10.1.4 Weevils (*Ceuthorrhynchus* spp., *C. assimilis* and *C. quadridens*)

The cabbage seed weevil and cabbage stem weevil invade crops of oilseed rape in spring, feed on leaves and lay eggs (according to weevil species) in pods or stems. Leaf damage to Watercress is usually not significant but serious contamination may follow emigration of new generation adults from oilseed rape at the end of the blossom period and during crop senescence prior to harvest.

Cultural control: *None .*

Chemical control: No products are currently approved.

8.10.1.5 Peach blossom aphid (*Myzus persicae*)

This polyphagous aphid overwinters on a wide range of hosts, including brassicas, potatoes and herbaceous plants. The winged aphids migrate readily between hosts in the summer months. They arrive on Watercress in numbers and timings that vary greatly from year-to-year. This species often feeds on Watercress during the summer and severe infestation may cause serious crop losses.

Cultural control: *None* .

Chemical control: No products are currently approved.

8.10.1.6 Chironomid midge larvae

This group of midges includes *Mefriocnemus hirticollis* . The larvae of chironomid midges live in fresh water where they attach to Watercress plants and cannot easily be washed off. They feed mainly on decaying vegetation around the plant roots, but may also be found at the surface film and on the aerial parts of the plant. While physical damage to healthy plant tissue is unlikely under UK conditions, the presence of chironomid larvae is a principal cause of customer complaints.

Cultural control: *Harvesting during the drier part of the day, when larvae move down the stems.*

Chemical control: Where problems occur, *Bacillus thuringiensis israeliensis* may be used.

Selection of insecticides

A list of insecticides currently approved for use is given in Appendix 2.

Great care must be taken to read the SOLA 'Notice of Approval' document. This is particularly important in respect of the number of applications permitted on a crop.

The regular inspection of crops is essential. Early treatment with a suitable insecticide can result in early elimination of the pest, often alleviating the need for follow up treatments, where this is permitted. However established infestations, especially aphids, should be avoided since they can often be difficult to deal with and may not be controlled within the permitted number of applications, which is often only one.

When selecting a pesticide, consideration must always be given to the effect the product will have on natural predators.

8.10.2 Disease control

With the exception of crook root, all diseases requiring control occur at the propagation stage rather than in cropping beds. It is important to apply high standards of hygiene to production surfaces between crops to minimise the need for subsequent chemical use. However, fungal infections are an ever present risk under propagation conditions, and local experience will provide an important guide to the main problems and most effective product or product combinations. Watercress diseases have most impact during dull, cool weather when the crop is unable to grow away. These conditions coincide with the main periods of seedling production in the spring and autumn.

8.10.2.1 Damping off (*Pythium* spp .)

Life history and problems caused: *Pythium* is very common eg. *P. ultimum* (syn. *P. debaryanum*). All other species implicated in 'damping off' are adapted to life in soil. Soft underground plant tissues are attacked when conditions are wet, especially if plant growth is slow; aerial parts are unaffected unless in contact with

soil. Symptoms are typically loss of root system and lack of plant vigour; some species only attack the root tips, which turn from white to brown and collapse. *Pythium* spp. are generally not aggressive fungi and attack is usually confined to young, weak or dead host tissue. Infection originates from infected plant residues containing thick-walled resting or survival spores called oospores, or from contaminated growth containers or water supplies. Most *Pythium* spp. are self-compatible and require only one strain for sexual reproduction and oospore production. At 'low' temperature (10-17°C) the resting spores produce a germ tube that gives rise to the motile zoospores, which continue the infection cycle. It is now possible to distinguish some *Pythium* species using diagnostic 'kits' and further refinements are expected with this technique.

Cultural control: *Washing and disinfecting of trays and the floors of propagation units between crops helps to minimise disease risk. Peat and compost should always be from sources that have not been exposed to the fungus, e.g. by contaminated dust, or water. The water supply must be kept free from sources of infection.*

Chemical control: Where there is reason to expect problems, propamocarb hydrochloride may be applied as a pre-emergence drench.

8.10.2.2 *Phytophthora* spp.

Life cycle and background: *Phytophthora* belongs to the same fungal group as *Pythium* and most species are also adapted to life in the soil environment. *Phytophthora* differs from *Pythium* by mostly attacking the roots of woody plants rather than soft tissues, and hence symptoms are less obvious. *P. cryptogea*, *P. erythrosetica* and *P. porri* are species that attack soft tissue typically causing crown and root rots ('shanking'), leaf yellowing and browning, and general loss of vigour, however these fungi are more usually associated with plant species other than Watercress. The life cycle has many similarities to *Pythium* except that two different strains are needed for sexual reproduction and production of the resting spores; the sources of infection are also the same as *Pythium*.

Cultural control: *Washing and disinfecting of trays and the floors of propagation units between crops helps to minimise disease risk. Peat and compost should always be from sources which have not been exposed to the fungus, e.g. by contaminated dust, or water. The water supply must be kept free from sources of infection.*

Chemical control: When experience suggests *Phytophthora* is likely to cause a problem for seedlings, then propamocarb hydrochloride should be applied pre-emergence to the peat/compost in accordance with the conditions of approval.

8.10.2.3 Stem rot (*Rhizoctonia solani*)

Life cycle and background: *Rhizoctonia solani* affects soft underground plant parts causing seedling collapse and shallow brown lesions on older tissues. The fungus is ubiquitous, attacks a wide range of plant species, and is active in dry and wet conditions. *R. solani* comprises 12 different 'anastomosis groups' (AG) based on their compatibility to each other with AG2-1 being commonly associated with the *Cruciferae*. Individual isolates can be selectively pathogenic to one or several plant species but not to others. The life cycle is mostly as the asexual hyphal state which is active in dead plant remains; these dead remains later become a means of survival between crops, the fungus may be presented in growth media or 'compost'. The sources of *R. solani* are dead infected roots of a range of plant species, and contaminated growth containers. Water contamination is unlikely to be a problem.

Cultural control: *Washing and disinfecting of trays and the floors of propagation units between crops helps to minimise disease risk. Peat and compost should always be from sources which have not been exposed to the fungus, e.g. by contaminated dust, or water. The water supply must be kept free from sources of infection.*

Chemical control: No products are currently approved.

8.10.2.4 Crook root (*Spongospora subterranea f. sp nasturtii*)

This disease is the vector for watercress yellow-spot and chlorotic leaf spot viruses, both of which can seriously damage or destroy the marketability of the crops. It invades the plants by means of zoospores that penetrate root cells. The organism then proliferates within the root, producing large numbers of further zoospores. At certain stages, resting spores are produced, and these are highly resistant to unfavourable environmental conditions. When conditions are again favourable, the resting spores become active, releasing zoospores, and the cycle is continued. Crook root is most damaging in winter when plants are growing more slowly. It is endemic to almost all UK cropping beds and extensive attempts to identify a commercially acceptable variety with useful levels of resistance to the disease have so far proved unsuccessful.

Cultural control: *Use of large volumes of water to irrigate the beds can reduce the rate of infection by washing away the zoospores. Regular replanting of beds with high populations of clean young plants is also helpful, as the viruses are not seed-borne.*

Chemical control: The addition of low concentrations of zinc into the inlet water above the beds when the disease is most damaging between October and April has proved effective in reducing infection. Defra has recognised the use of zinc as a commodity chemical.

8.10.3 Weed control

No herbicides have been approved with use of Watercress. Hand weeding is the only option available.

9 Harvesting and storage

See Generic Standards and/or Generic Guidance Notes.

Domestic animals should be excluded from production and packing areas.

10 Pollution control and waste management

See Generic Standards and/or Generic Guidance Notes.

There are legal requirements for making discharges to watercourses, and accordingly:

- discharges from the production beds to watercourses must be made with the consent of the Environment Agency (EA).
- any use of zinc on the crop must conform with EA requirements.
- crop removal and bed preparation must be conducted so as to minimise suspended solids discharges to watercourses, in accordance with the procedures agreed with the EA for intensive or traditional farms.

In addition:

- chlorinated water discharges from packing operations should be made to foul sewers, or treated to neutralise the chlorine before discharge.

11 Energy efficiency

See Generic Standards and/or Generic Guidance Notes.

12 Health & Safety

See Generic Standards and/or Generic Guidance Notes.

13 Conservation issues

See Generic Standards and/or Generic Guidance Notes.

Appendix 1 Nutrients

It is not possible to give fertiliser application rates as Watercress obtains much of its nutrient requirements from the flowing water in which it grows. The amount of 'top-up' required will vary with the nutrient content and flow rate of the water.

Appendix 2 Insecticides currently approved for use on Watercress cropping beds

Active Ingredient	Product Features	Approval Type	Harvest Interval ⁽¹⁾	LERAP Category	Hazard Rating	MRL (mg/kg)
<i>Bacillus thuringiensis</i> var. kurstaki		SOLA 20031071	0 days	none stated	none stated	none set
<i>Bacillus thuringiensis</i> <i>israeliensis</i>		SOLA 20063149	0 days	none stated	none stated	none set

Notes:

⁽¹⁾ or latest time of application

Not all products containing these active ingredients may be currently approved for use on Watercress. As label recommendations are revised regularly, read a current label before use.

Appendix 3 Insecticides currently approved for use in propagating Watercress

Active Ingredient	Product Features	Approval Type	Harvest Interval ⁽¹⁾	LERAP Category	Hazard Rating	MRL (mg/kg)
<i>Bacillus thuringiensis</i> var. kurstaki		SOLA 20031071	0 days	none stated	none stated	none set
<i>Bacillus thuringiensis</i> <i>israeliensis</i>		SOLA 20063149	0 days	none stated	none stated	none set

Notes:

(1) or latest time of application

Not all products containing these active ingredients may be currently approved for use on Watercress. As label recommendations are revised regularly, read a current label before use.

Appendix 4 Fungicides currently approved for use in propagating Watercress

Active Ingredient	Product Features	Approval Type	Harvest Interval ⁽¹⁾	LERAP Category	Hazard Rating	MRL (mg/kg)
fosetyl-aluminium	water dispersible granules, systemic phosphonic fungicide.	SOLAs 20071260 20073564 20080272	1 day after seeding	none stated	none stated	none set
propamocarb hydrochloride	soluble concentrate. Harmful to fish and aquatic life.	SOLAs 20010439 20072947 20073425	28 days	none stated	Irritant	none set
metalaxyl-M	systemic phenylamide fungicide, liquid concentrate.	SOLA 20072193	none stated	none stated	none stated	.05 mg/kg
copper oxychloride	suspension concentrate. Harmful to fish and aquatic life.	SOLAs 20001538 20080156	none stated	none stated	none stated	none set

Notes:

(1) or latest time of application

Not all products containing these active ingredients may be currently approved for use on Watercress. As label recommendations are revised regularly, read a current label before use.

Appendix 5 Specific off-label approvals for Watercress

Number	Product Name	Ingredients	Expiry
20031071	DiPel DF [®]	<i>Bacillus thuringiensis</i> var. <i>kurstaki</i>	31/12/13
20063149	Vectobac 12 AS	<i>Bacillus thuringiensis</i> <i>israeliensis</i>	01/02/10
20001538	Cuprokylt FL [®]	copper oxychloride	31/12/13
20080156	Headland Inorganic Liquid Copper [®]	copper oxychloride	31/12/13
20071260	Aliette 80 WG [®]	fosetyl-aluminium	30/04/12
20080272	Standon Fullstop [®]	fosetyl-aluminium	30/04/12
20073564	Clean Crop Chicane [®]	fosetyl-aluminium	31/05/09
20072193	SL 567A [®]	metalaxyl-M	30/09/12
20010439	Filex [®]	propamocarb hydrochloride	31/12/13
20072947 20073425	Proplant [®]	propamocarb hydrochloride	31/12/13 30/09/09

Notes:

Specific off-label approvals (SOLAs) provide for the use of the product named in respect of crops, situations or pests other than those included on the product label. Such use is undertaken at the user's choosing and the risk is entirely theirs.

Specific off-label uses may only take place if all the conditions given in the "Notice of Approval" document, the product label and/or leaflet and any additional guidance on off-label approvals have first been read and understood. The conditions of approval given in the "Notice of Approval" are statutory and supersede any on the label which would otherwise apply.

All SOLAs are conditional on the extant approval of the specific product.

Appendix 6 Control Points: Watercress

CS.19 WATERCRESS

- CS.19.1 The crop must be grown in flowing water of high microbial quality.
- Protocol reference: Section 1.1
- CS.19.2 *Deleted 2009*
- CS.19.3 Water carriers and production beds must be protected from the intrusion of livestock
- Protocol reference: Section 1.1
- CS.19.4 Domestic animals should be excluded from production and packaging areas
- Protocol reference: Section 9
- CS.19.5 Discharges from the production beds to watercourses must be consented to by the Environment Agency (EA)
- Protocol reference: Section 10
- CS.19.6 Any use of zinc on the crop must conform with EA requirements
- Protocol reference: Section 10
- CS.19.7 Crop removal and bed preparation must be conducted so as to minimise suspended solids discharges to watercourses, in accordance with the procedures agreed with the EA for intensive or traditional farms, as appropriate
- Protocol reference: Section 10
- CS.19.8 Chlorinated water discharges from packing operations should be made to foul sewers, or treated to neutralise the chlorine before discharge
- Protocol reference: Section 10
- CS.19.9 Growers must test water used in production beds and any propagation unit for microbial contamination including *E.coli*
- Protocol reference: Section 1.1
- CS.19.10 Growers must test the growing medium used in any propagation unit for microbial contamination including *E.coli*
- Protocol reference: Section 1.1