Crop Module: Watercress
Effective 1st September 2015
This crop specific module for watercress has been written to complement and avoid duplicating the generic principles of the Red Tractor Farm Assurance Fresh Produce Scheme standards. It is advisable to read the Red Tractor Farm Assurance Fresh Produce standards before reading this crop specific module. This module is designed to stimulate thought in the mind of the reader. It contains crop specific guidance and standards, where applicable, in addition to the requirements stated in the generic Fresh Produce standards.

Within this module the important requirements outlined in the crop specific standards section will be verified during the Red Tractor Farm Assurance assessment and compliance will form a part of the certification/approval decision.

Disclaimer and trade mark acknowledgement

Although every effort has been made to ensure accuracy, Assured Food Standards does not accept any responsibility for errors and omissions. Trade names are only used in this module where use of that specific product is essential. All such products are annotated® and all trademark rights are hereby acknowledged.

Notes: Pesticide Information

The Red Tractor Fresh Produce team has been working with Fera to provide tailored access to the LIAISON database for all Red Tractor Fresh Produce members. This system allows individual growers access to all information for plant protection products approved for use under the Red Tractor Fresh Produce Scheme.

LIAISON can be accessed under the Produce tab via the “Checkers and Services” page where you will also find a user manual. Searches will be filtered specifically for the crops for which you are registered. Once you have logged onto the site and clicked on the LIAISON hyperlink you will be directed to the LIAISON home screen.

You will need a username and password and these will be sent once you have registered:

http://assurance.redtractor.org.uk/rtassurance/services/Registration/members.eb

General Introduction

Following a systematic approach will help growers identify and manage the risks involved in crop production. This module is based on a typical crop production process and 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 precedent over quality and environmental controls. The layout of this module follows the same structure as that used in the Red Tractor Farm Assurance Fresh Produce Standards. The content of the module is reviewed prior to the issue of updated editions. The review process considers both new developments and all relevant technology which has emerged since the last review was completed and which have been found to be both workable by the grower and beneficial to the environment. The aim is to transfer such information and technologies to growers.

Acknowledgements

Red Tractor Farm Assurance Fresh Produce gratefully acknowledges the contribution of all consultees in the preparation of this protocol, particularly the NFU-Watercress Association and Michael Payne.

The protocol covers watercress grown in purpose built cropping beds in flowing water. It relates to the cultivation of watercress and includes the management of microbial food pathogen risk associated with this. It does not cover post-harvest operations, and does not deal with quality aspects of the crop or with health and safety. The protocol (including the control points) is not intended as an exhaustive grower’s guide and nor should it be regarded as exhaustive.

The protocol is additional to the Fresh Produce Standards and watercress growers must comply with all the Fresh Produce Standards applicable to their business.
### ADDITIONAL REQUIREMENTS AGAINST CURRENT STANDARDS

<table>
<thead>
<tr>
<th>STANDARDS</th>
<th>HOW YOU WILL BE MEASURED</th>
<th>RECORDS (to be kept for 2 years)</th>
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<tr>
<td>TI.b</td>
<td>This also includes cuttings</td>
<td>Seed/ plant/ cutting traceability records</td>
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<tr>
<td><strong>Records of bought in seeds or plants must be kept</strong></td>
<td>Records should also include: – the place of origin</td>
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### CROP SPECIFIC STANDARDS

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<th>STANDARDS</th>
<th>HOW YOU WILL BE MEASURED</th>
<th>RECORDS (to be kept for 2 years)</th>
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<tr>
<td>CQ.19.a</td>
<td>section 2.1 of Appendix 1 provides additional information</td>
<td>microbial testing records</td>
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<tr>
<td><strong>Each batch of material for propagation (seed, seedlings and cuttings) must be randomly sampled and tested to verify it is free from microbial contamination</strong></td>
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<tr>
<td>CQ.19.b</td>
<td>Documentation must be available to demonstrate that a preventative approach has been employed in the production of seeds and that they have been produced in accordance with Good Agriculture Practice</td>
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<td></td>
<td>Bought-in seeds: Certificate which confirms seeds have been produced in line with GAP</td>
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<td>CQ.19.c</td>
<td>A disease analysis or a Certificate of Compliance from the substrate producer must be available for each batch of material</td>
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<td>Disease analysis/ Certificate of Compliance</td>
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<tr>
<td>CQ.19.d</td>
<td>Records of analysis for microbial contamination of water used in propagation must be available and test results must be plotted on a graph</td>
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<tr>
<td></td>
<td>water is of high microbial quality - requirements for the quality of water are set out in Appendix 1, section 4.3 ‘Microbial Quality for water used in Watercress production’</td>
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<td></td>
<td>any deterioration in the quality of the water is investigated</td>
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<td></td>
<td>Records of microbial analysis of water</td>
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<td></td>
<td>Graph of test results Records of actions taken where deterioration has been found</td>
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<tr>
<td>CQ.19.e</td>
<td>A permit covering discharges of water to the aquatic environment must be obtained from the Environment Agency</td>
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<td>EA permit</td>
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<tr>
<td>CQ.19.f</td>
<td>Procedures must be in place to check whether surface water may have entered the crop</td>
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<td>Written procedure in place</td>
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<td>CQ.19.g</td>
<td>Drains within the growers control must be tested annually for leaks, and more frequently if there is reason to suspect a leak</td>
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<td></td>
<td>Records of tests and any actions taken</td>
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<tr>
<td>CQ.19.h</td>
<td>If fertilisers containing organic materials are used, a disease analysis or a Certificate of Compliance from the fertiliser producer must be available for each batch of material</td>
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<td></td>
<td>Disease analysis/ Certificate of Compliance</td>
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<tr>
<td>CQ.19.i</td>
<td>The Fresh Produce Standards relating irrigation must also be applied to the all the sources of water supplying the cropping beds or used for seedling propagation</td>
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<tr>
<td>CQ.19.j</td>
<td>The water in production beds must be flowing</td>
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<td>CQ.19.k</td>
<td>Production must have impermeable sides to mitigate the risk of contaminated water entering the beds</td>
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<td>CQ.19.l</td>
<td>Growers must ensure that effective physical barriers are in place to prevent all livestock gaining access to production sites</td>
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<tr>
<td>CQ.19.m</td>
<td>Growers must ensure that effective physical barriers are in place to prevent run-off from surrounding land contaminated with animal faeces entering production sites</td>
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<tr>
<td>CQ.19.n</td>
<td>Measures must be in place to reduce the risk of mud snails entering the production site</td>
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<td></td>
<td>gravel tracks are maintained around the perimeter of the site or cropping beds are edged with concrete</td>
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<tr>
<td>CQ.19.o</td>
<td>Growers must have prominent notices informing the public that the farm is a food production area and that the public and animals are not permitted, and where there is public access that animals must be kept on rights of way</td>
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<tr>
<td>CQ.19.p</td>
<td>All equipment used in the handling and packing of watercress must be rinsed with potable water after cleaning agents have been used</td>
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<tr>
<td>CQ.19.q</td>
<td>All records relating to water analysis must be kept for at least 5 years</td>
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### GUIDANCE

#### CHOICE OF VARIETY OR ROOTSTOCK AND PLANT HEALTH CERTIFICATION

**RISK ASSESSMENT**

In the interests of food safety the Fresh Produce Standards require growers to carry out a RISK ASSESSMENT for all products from planting through to packing and storage. The Risk Assessment should inter alia cover physical, chemical and microbiological contamination. An introduction to Risk Assessment (such as HACCP) is included at Appendix RA.a to the Fresh Produce Standards (version 3.0).

Identifying the microbial risks and preventing microbial contamination of the end product is particularly important in the production of watercress since it is very often eaten raw. Appendices to this protocol are designed to give support in this area and should be read in conjunction with the protocol. Some background information on food poisoning outbreaks and pathogens is included in Appendix 1: ‘Information for Mitigation of Microbial and Viral Pathogens in watercress’. Guidelines on carrying out effective Risk Assessments and mitigating the risks are included in Appendix 2: ‘Watercress Micro Risk Management Guidelines’. The Guidelines include potential areas of contamination risk and examples of actions. There is further information in HDC Factsheet 13/10 ‘Monitoring microbial food safety of fresh produce’

http://assurance.redtractor.org.uk/rtassurance/schemes/resources/content/Fresh%20Produce.eb

Some pathogens (e.g. E coli 0157 and Cryptosporidium) have a low infective dose with only relatively few organisms being required to produce infection. Even a low level contamination may therefore have consequences for food safety and this should be factored into the Risk Assessment.

When carrying out the microbial Risk Assessments it is important that growers identify all potential sources of human pathogens and all potential pathways by which such contaminants could enter production sites, cropping beds and packing areas. This includes all the food safety points outlined in this protocol including the control points and the Appendices, and also any other risks to food safety identified during the risk assessment process.

The risks of microbial contamination will vary from site to site since sources and pathways of potential contamination will differ for each production site. For the purposes of this protocol, a microbial Risk Assessment is therefore necessary for each production site. This must be undertaken annually, or more frequently should circumstances change.

Each production site must be managed in accordance with the outcome of the site risk assessment and any risks identified must have an action plan in place to minimise the risk of microbial contamination of the crop. The action plan must be implemented and the measures taken must be recorded.

#### SEED, NURSERY STOCK AND ROOTSTOCK

**Propagation**

Watercress is propagated by seeding or by placing cuttings directly into the production beds, or by growing seedlings under protection and planting out. The propagation material (seed, seedlings and cuttings) is a potential source of human and plant pathogens and hence a possible route by which microbial contamination can enter cropping beds and potentially contaminate the crop. The growing medium, the water and equipment used in propagation, and the workers carrying out propagation are also possible routes. Propagation is covered in section 2 of the Micro Risk Management Guidelines (Appendix 2).
Propagation material

Each batch of material for propagation (seed, seedlings and cuttings) must be randomly sampled and tested to verify it is free from microbial contamination (see section 2.1 of Appendix 2). Records of analysis must be available.

However, according to the Food Standards Agency (FSA), “isolating bacteria from contaminated seeds has proved extremely challenging with available technologies”and FSA states “Only use seeds of known provenance which have been produced in accordance with Good Agricultural Practice “, (referring to the Codex Alimentarius Code of Good Hygienic Practice for Fresh Fruit and Vegetables (2010), CAC/RCP 53-2003). Documentation must therefore be available to demonstrate that a preventative approach has been employed in the production of seeds and that they have been produced in accordance with Good Agriculture Practice.

Similarly, growers should not rely exclusively on testing of samples to verify seedlings and cuttings are free from pathogens. Documentation that a preventative approach has been employed in their production in accordance with Good Agricultural Practice must be available (see section 2.1 of Appendix 2).

The Fresh Produce Standards require records of bought-in seeds or plants to be kept (TI.b). However, for the purposes of this protocol, records must be available for each batch of propagation material, including for cuttings, whether they are bought-in or produced within the business. The records must detail each stage in the supply chain, including the supplier of origin, and the place of origin, as well as the information required in the Fresh Produce Standards (TI.b).

Growing medium/substrate

Where growing medium/substrate is used for propagation, this can be a potential source of microbial contamination. Peat particularly can have variable levels of E. coli present.

A disease analysis or a Certificate of Compliance from the substrate producer must be available for each batch of material (see section 2.2 of Appendix 2).

Water

The water used in propagation should be of high microbial quality. Records of analysis for microbial contamination of this water must be available and test results must be plotted on a graph (as set out in the Irrigation section (IG)).

Equipment

Equipment used in propagation must be cleaned and disinfected. Records of cleaning must be available (see section 5.0 of Appendix 2).

SN.1.5 Worker Hygiene

A high standard of worker hygiene is required throughout the propagation process, including the production of propagation material (see section 4.0 & 5.0 of Appendix 2).

SITE AND SOIL MANAGEMENT

Watercress farms are often located in valley bottoms and production sites are therefore at risk of contamination from runoff from higher ground, ingress of mud snails from damp pastures, and river flooding. Each production site must be managed in accordance with outcome of the site Risk Assessment (see section RA in the generic Fresh Produce manual and section 3.0 and 4.0 of the Micro Risk Management Guidelines (Appendix 2)).

ENVIRONMENTAL IMPACT/ CONSERVATION AND SUSTAINABILITY

In implementing the EI standards, growers should be aware that watercress farms are frequently located in areas of high conservation interest and that the rivers to which they discharge may have conservation designations such as the EU Special Area of Conservation (SACs) and national Sites of Special Scientific Interest (SSSIs).

Audit

In carrying out a baseline audit (as recommended at EI.d), growers should be aware that their production sites may be inhabited by protected species such as water voles which are UK Biodiversity Action Programme priority species.

Also, due to their waterside location, watercress farms may be prone to colonisation by invasive non-native plant species e.g. Himalayan Balsam, Japanese Knotweed and Giant Hogweed. These form dense stands which displace native plants and reduce wildlife interest and are classified as invasive species under the EU Water Framework Directive. It is a legal requirement that land owners and occupiers do not allow such plants to spread onto adjoining land, or plant or encourage the spread of invasive plants outside of their property. Government guidance explains that this can include moving contaminated soil from one place to another or incorrectly handling and transporting contaminated material and plant cuttings.

It is suggested that growers control invasive non-native plant species as they appear rather than allow them to become established.

For further information, including how to identify and control these plants, see https://www.gov.uk/japanese-knotweed-giant-hogweed-and-other-invasive-plants
ENVIRONMENTAL PROTECTION & CONTAMINATION CONTROL

Water Pollution

Since watercress farms are sited close to watercourses their activities represent a high risk to the ecology of the rivers to which they discharge. This is particularly the case for discharges of phosphorus.

Discharges of water to the aquatic environment are regulated by the Environment Agency (EA) by means of the Environmental Permitting (England and Wales) Regulations 2010. A permit must be obtained and growers are legally required to comply with the conditions of permits. EA guidance on complying with permits is contained in its Technical Guidance Note: ‘Trade operations - Watercress Farms’ available at:


One of the substances controlled under permitting is sediment (suspended solids). Settlement facilities are normally necessary to achieve the permitted level.

Zinc is also controlled by permitting discharge of chlorine or products containing reactive chlorine to the aquatic environment is not permitted by the EA. EA guidance on disposal of chlorine is contained in its Technical Guidance Note for Watercress Farms referred to above.

Limits for phosphorus have recently been added to permits for those watercress farms discharging to Special Areas of Conservation (SACs) designated under the European Habitats Directive. The potential effects of phosphorus discharges are also under increasing scrutiny as part of the implementation of the European Water Framework Directive (WFD). It is possible that phosphorous controls may be extended to other watercress farms.

To minimise losses of nutrients to the water environment, applications should not exceed crop requirements. EA considers it best practice to apply phosphorus fertilisers in insoluble form to help reduce the amount of phosphorus in discharges. It also considers it best practice to use nitrogen fertilisers primarily containing nitrogen in forms other than ammonia to minimise the risk of discharging ammonia.

Watercress farms generally discharge less nitrogen than is contained in the inflow water. Defra has stated that Nitrate Vulnerable Zone (NVZ) regulations will not be enforced at watercress farms.

There will also be risks to the aquatic environment from the storage on site of potentially polluting materials such as fertilisers, pesticides, disinfectant, cleaning materials, oils, and wastes, including bed cleanings. A high standard of environmental protection is therefore required in relation to the escape or spillage of potential pollutants.

Waste Management

Waste management is regulated by the EA by means of environmental permits and by exemptions from permitting under the Environmental Permitting (England and Wales) Regulations 2010. Exemptions are allowed for some agricultural and horticultural activities. The exemptions are subject to conditions which should be complied with for the exemption to be valid. Most exemptions have to be registered with the EA. A small number do not have to be registered, but the conditions for these exemptions still have to be complied with. Details of exemptions can be found at http://www.environment-agency.gov.uk/business/sectors/32779.aspx.

Water Abstraction Licensing

Water abstracted for use in growing watercress is regulated by the EA except where abstractions are exempt from licensing. The EA requires growers to comply with the licence conditions.

Contamination Control

It is important that controls are implemented to protect against the risk of contamination entering the crop from off-site as well as on-site sources (see sections 3 and 4 of the Micro Risk Management Guidelines (Appendix 2)).

For example, there is a risk that the water in the cropping beds could become contaminated by run-off from neighbouring land that may contain human pathogens, for example in soil, animal faeces, un-sterilised recycled materials such as sewage sludge and abattoir wastes. Crops could also become contaminated by flood water entering the cropping beds, which could contain the same substances as run-off. Flood water may also contain untreated human sewage and is also more likely to contain chemical contaminants from local industry.

Food Standards Agency (FSA) guidance is not to harvest when there is any evidence that surface water may have entered the crop. The FSA’s website recommends waiting at least six months after an area has been flooded before harvesting any new crops. (www.food.gov.uk/policy-advice/microbiology/flood). Procedures must be in place to check whether surface water may have entered the crop.
There may also be microbial risks to the water used for growing the crop. This may for example arise from leaking foul drains (both on- and off-site) and from sewers, and from organic materials such as livestock manures if applied too close to a borehole or spring (see below). Where there is a possibility that material being leaked from foul drains under growers’ control could reach source water or cropping beds (including in surface as well as sub-surface flow), the drains must be tested annually, and more frequently if there is reason to suspect a leak. Records of tests and actions taken must be available.

Springs and boreholes used for watercress production are protected by Source Protection Zones (SPZs) drawn up by the EA. Within these zones, activities which may cause pollution are regulated to protect the water sources. In 2015 General Binding Rules (GBRs) were introduced for small sewage discharges (SSDs). One of these rules (GBR 7) is that ‘The discharge must not be within a groundwater Source Protection Zone 1 or within 50 metres from any spring, well or borehole that is used to supply water for domestic or food production purposes. (There are 3 zones in an SPZ. SPZ 1 is the closest to the source.)

It is a breach of NVZ regulations for farmers to spread organic manures within 50m of springs, wells and boreholes, and outside NVZs it is good practice not to do so. It is recommended that growers ensure their neighbours are aware of the location of springs and boreholes used for watercress production.

Fertilisers

If fertilisers containing organic materials are used, a disease analysis or a Certificate of Compliance from the fertiliser producer must be available for each batch of material (see section 2.3 of the Micro Risk Management Guidelines (Appendix 2)).

Plant Protection Products

Very few pesticides are now approved for use on watercress. Those permitted can only be applied in very small quantities and under very limited conditions, and none can be used in a tank mix.

Section EC of the Fresh Produce Standards contains a large number of standards relating to pesticides and these are applicable to watercress production where pesticides are used.

Approved Uses Not Included on the Product Label

No products have label recommendation for use on watercress. Any product which may be used therefore requires specific off-label approval. Growers wishing to check the approval notice of a particular product should note that this information is available using the LIAISON® search accessible via their Red Tractor Farm Assurance home page after logging in.

A search on the ‘Extension of Authorisation for Minor Uses’ (EAMU) page of LIAISON® by crop or product name should yield a results page. A click on the EAMU number will open up the relevant Approval of Off-Label Use document giving details of the extension of use.

Pesticide Handling and Application Equipment

About half of all pesticide losses to the environment arise from handling (e.g. filling, mixing and washing containers and equipment). The foil seals on containers are one of the main sources of these losses. Growers should therefore take particular care with these.

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

INTEGRATED CROP MANAGEMENT

ICM 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 should have a thorough knowledge of crop protection, especially of beneficial insects and the need to protect wildlife.

It would be impossible to lay down absolute guidelines as these will vary with growing techniques, including with geographic locations and some growers have greater pest and disease pressure than others. An awareness of the prevailing conditions is required, which incorporates factors such as pest, disease and meteorological forecasts as well as the status of pests or disease present.

PEST CONTROL

Pest control relies almost entirely on cultural measures, for example by restricting the bed outlet to flood the crop, and some crops may be spray irrigated as a form of cultural pest control.

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.

**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.

**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 can be significant and 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.

**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 at 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.

**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:** The Bacillus thuringiensis product ‘Vectobac’ is currently available, although the approval was due to expire in 2014. Growers should check the approval is still current before using the product.

**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.

**Damping off (Pythium spp.)**

Life history and problems caused: Pythium is very common e.g. 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 should be kept free from sources of infection.

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. erythroseptica 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 should be kept free from sources of infection.

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. The water supply should be kept free from sources of infection.

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.

Weed control

No herbicides have been approved for use on the watercress crop. Hand weeding is the only option available.

IRRIGATION - INCLUDING THE WATER IN WHICH WATERCRESS IS GROWN

Some watercress crops may be spray irrigated as a form of cultural pest control, but water used for this is a small proportion of a farm’s overall usage. Almost all of the water used for growing watercress is returned to the water environment i.e. its use is non-consumptive. The EA recognises this. Indeed, water discharged from watercress farms can play an important role in maintaining river flows, including in some cases as part of EA river support schemes.

Since watercress is very often eaten raw, the quality of the water in which watercress is grown is particularly important in respect of its microbial safety. The Standards relating to the quality of irrigation water must therefore also be applied to the all the sources of water supplying the cropping beds or used for seedling propagation. Records of analysis should be retained for at least 5 years.
The water must be of high microbial quality. All test results must be plotted on a graph. This will help with early identification of any deterioration in the quality of the water which must be investigated. Red Tractor’s requirements for the quality of water are set out in Appendix 2, section 4.3 ‘Microbial Quality for water used in Watercress production’.

Any concerns identified as a result of the sampling must be addressed and, the actions taken must be recorded.

Fact Sheet 13/10 ‘Monitoring Microbial Food Safety of Fresh Produce’ available on the Red Tractor website provides information and guidance:

http://assurance.redtractor.org.uk/rtassurance/schemes/resources/content/Fresh%20Produce.eb

Microbial analysis of all sources of water used in growing the crop and in propagation should be undertaken by a laboratory accredited to ISO 17025 (as recommended in Fresh Produce Standard IG.4.3 for Irrigation Water; see section 4.0 of Appendix 2).

The water in production beds must be flowing and the beds must have impermeable sides to mitigate the risk of contaminated water entering the beds.

HARVEST AND FIELD PACKING

The Fresh Produce Standards must be applied to the growing of watercress i.e. to pre-harvest operations, as well as to harvesting and field packing. Worker hygiene is important in growing since considerable amounts of handwork are involved and the water in which the crop is grown provides a medium which could allow contamination to spread widely. (See section 5.0 of Appendix 2)

Hygiene is covered in section 5 of Appendix 2.

Chill chain integrity (see section 6 ‘Post Harvest’ of Appendix 2.)

VERMIN CONTROL

INCLUDING WILDLIFE, DOMESTIC ANIMALS AND LIVESTOCK

Some vermin, animals and wildlife, can be a source of human pathogens. Examples of such pathogens include E. coli O157, Salmonella, Cryptosporidium, Listeria, Campylobacter and liver fluke (Fasciola hepatica).

Some pathogens can be waterborne which has particular implications for watercress production. Potential areas of contamination risk and examples of actions are included at sections 3 and 4.4 of Appendix 1b.

Livestock

All livestock are potential sources of human pathogens and cattle and sheep are major reservoirs of E.coli 0157. Young lambs and calves in particular can be sources of Cryptosporidium.

Where practical, the Food Standards Agency (FSA) considers that grazing of livestock in close proximity to watercress production sites should be avoided. Where this is not practical, FSA states that the potential risks should be mitigated as far as possible and that it would be better to focus on ensuring effective physical barriers are in place. The FSA consider the same considerations apply to land grazed by horses and ponies.

There may also be potential risks of microbial contamination entering the production site in runoff from surrounding land used for grazing or where the land has been used for spreading manure, slurry or dirty water (e.g. from yard or parlour washings), or for manure storage.

Growers must ensure that effective physical barriers are in place to prevent livestock, including horses and ponies, gaining access to production sites and to prevent run-off from surrounding land contaminated with animal faeces entering production sites (see section 3.1 of Appendix 2). This control is also required to help protect against other contaminants that may be present in run-off such as soil, sewage sludge and abattoir wastes (as mentioned in Contamination Control).

Growers should also be aware that contamination from livestock faeces may be trafficked onto production sites from further away, for example by vehicles, people, and by wildlife and domestic animals and this should be factored into the site Risk Assessment.

Livestock tend to be prevalent in watercress growing areas. This means that liver fluke may be a risk since mud snails which carry the infective stage of the fluke may be present on pastures, particularly if they are wet pastures. Liver fluke larvae from these snails can infect humans and measures must be in place to reduce the risk of mud snails entering the production site. In the UK, examples of measures used by growers to help protect watercress from liver fluke include maintaining gravel tracks around the perimeter of the site and edging the cropping beds with concrete.

Vermin

Vermin, wildlife and domestic animals may be infected by human pathogens, and they may also traffic potentially contaminating material such as livestock faeces onto watercress farms (See section 3.2 of Appendix 2).
Growers should be aware that watercress farms may be inhabited by water voles which, as explained above, are a UK Biodiversity Action Programme priority species. Fresh Produce Standard VC.b requires baits to be used responsibly and refers to siting bait so that non-target animals do not have access. Where rodent control is contracted out, operators should be informed that water voles may be present.

**Domestic animals, wildlife and birds**

Where there are microbial risks to the crop from domestic animals, wildlife or birds accessing the production site, actions to mitigate the risks so far as reasonably practicable (such as fencing and bird scaring) should be taken (see section 3.2 of Appendix 2).

In the case of domestic animals such as dogs and horses, growers must have prominent notices informing the public that the farm is a food production area and that the public and animals are not permitted, and where there is public access that animals must be kept on rights of way.

**PRODUCE HANDLING AND PACKING**

**FOOD SAFETY**

A high standard of hygiene in handling the crop at all stages is necessary for food safety reasons. (See section 5.0 of Appendix 2).

Growers should be aware that traces of cleaning agents in excess of acceptable amounts have been found in bagged produce and that this has been traced to the cleaning of equipment (see Residues and Contaminants below). Equipment must be rinsed after cleaning agents have been used. The rinse water must be of drinking water quality (see above).

**RESIDUES AND CONTAMINANTS**

There are a number of standards relating to chemical residues and microbiological contamination in the Residues and Contaminants section (RC) of the Fresh Produce Standards.

**PESTICIDE RESIDUES**

Red Tractor Farm Assurance 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

**RESIDUE TESTING**

There are no identified pesticide residue issues associated with watercress but grower awareness needs to be maintained. However, growers should be aware that traces of quaternary ammonium compounds in excess of MRLs have been found in bagged produce. In watercress, these compounds are associated with cleaning agents (see Produce Handling and Packing above).

**TRACEABILITY AND INTEGRITY**

The Fresh Produce Standards relating to Traceability and Assurance Status include details of the records required. In the case of watercress, it is recommended that growers should also have an identity reference for each cropping bed.

**DOCUMENTS AND PROCEDURES**

The section in the Fresh Produce Standards on Documents and Procedures (DP) states that all records must be kept for at least two years unless otherwise specified in the standards. However, since watercress is grown in groundwater, growers must retain records relating to water analysis for at least 5 years. To help with identification and assessment of trends in water quality it is recommended that records are retained for 10 years.
APPENDIX 1: INFORMATION FOR MITIGATION OF MICROBIAL AND VIRAL PATHOGENS IN WATERCRESS

Background

These Appendices have been developed as a supplement to the existing watercress protocol and are aimed at giving growers the facility to identify and implement controls that are appropriate for the crop to minimise the risk of food pathogen contamination that would offer a risk to the end consumer.

Introduction

The last few years has seen an increasing number of food poisoning outbreaks associated with fresh produce. These have been primarily associated with salad and fruit crops including watercress, but in reality anything that can be eaten as it is harvested could carry a food poisoning organism if the controls are not effectively implemented in the planning, growing, harvesting, packing, cooling and transport phases.

Currently, crop production in the UK is probably one of the safest in the world with few historic issues seen but that does not mean it does not happen in the UK.

Why do these outbreaks occur?

Very simply the majority of food poisoning organisms we are talking about are associated with the direct or indirect contamination of the crops with faecal material from humans, animals, birds and insects.

Which organisms are we talking about?

(Note – for more detailed information please refer to HDC Factsheet 13/10 – Monitoring microbial food safety of fresh produce”)

Salmonella: can be found in animals (particularly pigs) and birds and on occasion reptiles.

E. coli (O157 and others): Can be found in about 15-20% of intensively housed cattle herds but also other farm animals.

Cryptosporidium: Protozoan parasite with the infectious stage being a large Oocyst, it is most commonly shed in livestock faeces.

Liver flukes: Present mainly in sheep faeces can be hosted by mud snails as an intermediate host.

Listeria: Naturally present in soil and water but also in the guts of animals.

Campylobacter: Most common from poultry but other animals and human guts.

Each of these bacteria can survive for many months in the environment and much longer in untreated manures.

There is also increasing concern about the risk associated with Viruses such as Hepatitis A and E and Norovirus. Many of the potential routes of contamination are the same as faecal pathogens, i.e. animal manures and contaminated water, a significant focus is on staff hygiene and controls.

What can we do?

In simplistic terms there are three basic areas than need to be focused on (diagram below is only a summary; full details are in Appendix 1b).

- Direct Contamination
  - Use of animal Manures in cropping
  - Direct faecal contamination from animal or wild life

- Cross Contamination
  - Use of contaminated water supplies
  - Poor staff hygiene

- Growth
  - Delayed cooling times
  - Poor chill chain management

The aim of these Appendices is to aid growers identifying the controls that need to be implemented to reduce the risk of contaminated fresh produce reaching the consumers. It is recognised that it will never be possible to eliminate all risks as crops by their very nature they are grown in an uncontrolled field environment, but where there are possible areas where farmers and growers can reduce risks, these should be identified and implemented.
APPENDIX 2: WATERCRESS MICRO RISK MANAGEMENT GUIDELINES

When a risk assessment has been carried out and a potential contamination risk identified, the appropriate controls and monitoring procedures should be clearly identified in a formal risk assessment (such as HACCP).

The guidance below is to be used as an Appendix to the watercress protocol to aid growers in carrying out effective risk assessments and developing effective risk mitigation strategies to minimise the risk of Human Pathogen presence in crops.

<table>
<thead>
<tr>
<th>Generic Area 1. Risk Assessment</th>
<th>Potential Areas of Contamination Risk</th>
<th>Examples of Actions that could be Implemented on Action Plan</th>
</tr>
</thead>
</table>
| 1.1 Formal Risk Assessment       | Failure to carry out a detailed risk assessment could result in food safety risk not being identified or not being effectively controlled | ■ Risk assessment should cover potential Microbial, Chemical and Physical food safety risks at each stage of production  
■ Risk assessment must be reviewed minimum annually  
■ Where risks have been identified, risk mitigation steps must be defined and implemented  
■ All appropriate staff must be made aware of control steps being implemented |

<table>
<thead>
<tr>
<th>Generic Area 2. Propagation</th>
<th>Potential Areas of Contamination Risk</th>
<th>Examples of Actions that could be Implemented on Action Plan</th>
</tr>
</thead>
</table>
| 2.1 Seed/Propagation Microbial Quality | Presence of Human Pathogens on seeds or propagation materials has the potential to contaminate the finished product | Types of issues that could be identified:  
■ Contaminated seed or plant material used in propagation where GAP has not been effectively implemented  
Examples of possible actions:  
■ Seed should be sourced form an approved, known, traceable supply chain  
■ Ideally, seed production GAP practices should be verified, i.e. water quality, use of manures, equipment hygiene  
■ Each seed batch should be tested for the presence of pathogens  
■ Supplier proved certificate of compliance with each batch |
| 2.2 Propagation Growing media/substrate | Growing media, particularly peat, are known to have faecal indicators such as E. coli present in them | ■ Each batch of material should be tested to verify free from pathogens  
■ Alternatively certificate of compliance provided by supplier should be obtained |
| 2.3 Fertilisers | If fertilisers that are made from animal manures of animal by-products are used then there is a potential of pathogen transfer if they were not effectively processed | Types of issues that could be identified:  
■ Contaminated of fertiliser due to poor composting or processing.  
Examples of possible actions:  
■ Obtain certificate of compliance from supplier  
■ Test each batch for microbial pathogens |
| 2.4 Water Quality | See Irrigation Section 3.2 | |
| 2.5 Equipment Hygiene | See Harvesting Section 4.2 | |
| 2.6 Staff Hygiene | See Harvesting Section 4.1 | |
### 3. Site Risk Assessment

#### 3.1 Activities neighbouring water supply and production areas

**Are there activities on land neighbouring the water supply and production sites, i.e. 1-2 km upstream that could contaminate cropping areas or water supply?**

**Types of issues that could be identified:**
- Livestock entering water course
- Run off from livestock operations
- Application of slurries and manures occurs within 1km of watercourse
- Composting of animal wastes occurs within 1km

**Examples of possible actions:**
- Fencing of land to restrict livestock entering watercourse
- Assess run off risk – slope of land and natural barriers from identified areas
- Installing barriers such as a ditch/soak away to stop run off entering water course in critical areas (i.e. taking effluent to areas downstream of production) from high risk activities such as manure/slurry storage after heavy rainfall
- Routine monitoring of water quality. by supplier should be obtained

#### 3.2 Wildlife and domestic animal activity

**Are there any specific issues with animal/bird activity that may affect crops, e.g. deer, sea birds, domestic animals, horses or kennels etc?**

**Types of issues that could be identified:**
- Public rights of way.
- Bird roosting sites or migrating to feeding sites, e.g. landfill
- Specific animal activity in the areas, e.g. deer

**Examples of possible actions:**
- Clear signage and barriers to prevent domestic animal entering production area
- Use of animals barriers and scaring to minimise activity in and around production areas
- Use of bird scarers to minimise activity in area

#### 3.3 Flooding/sewage

**Is the area prone to flooding and hence at risk of sewage contaminating watercourse (this does not include normal water build up following heavy rain) or leakage from foul water?**

**Types of issues that could be identified:**
- Localised flooding causing sewage from livestock or domestic facilities to contaminate watercourse
- Leakage from sewage and drainage systems on site

**Examples of possible actions:**
- Add vulnerable areas/outfalls from drainage systems to micro testing schedule
- Carry out documented annual assessment of local drainage systems
- If flooding occurs initial increased water/product testing
- Agree action plan with customer where appropriate
### 4. Water Supply

#### 4.1 Water Risk Assessment

As with all inputs, the risks posed to the crop must be understood and actions taken to mitigate against these. The Primary Producer must be able to demonstrate an understanding of the risks posed by their water supply, via annual risk assessment.

**Areas that should be covered in risk assessment:**
- Map of each water source used
- Assessment of stability and contamination risk of each source (as per risk assessment above on neighbouring activities)
- Details of any distribution and storage facilities
- Details of any water treatment

**Examples of Action to be taken, based on individual risk assessments:**
- Frequency of testing defined
- Controls to minimise risk identified (as above)

#### 4.2 Water Microbial Quality

Water used in production or propagation can become contaminated with human pathogens.

**Types of issues that could be identified:**
- Water is not of acceptable microbial quality
- Water microbial quality is compromised by contamination of the watercourse

**Examples of possible actions:**
- Routinely test water quality at various points on distribution system, as appropriate
- Develop trend analysis of the water test results to monitor normal quality and identify periods where out of specification
- Develop action plan with customer if water out of specification

#### 4.3 Water Testing

Testing carried out incorrectly or results incorrectly interpreted may result in unnecessary actions or risk indicators being missed.

**Use as a baseline, guidance laid out in HDC Factsheet 13/10 - Monitoring microbial food safety of fresh produce and [http://multimedia.food.gov.uk/multimedia/pdfs/microbial.pdf](http://multimedia.food.gov.uk/multimedia/pdfs/microbial.pdf) should be used to develop microbial testing plan**

**Actions:**
- A plan of testing must be in place for all water sources, which defines frequency of testing, organisms to be tested
- Testing must be carried out by independently accredited laboratories (e.g. ISO /IEC 17025:2005)
- Results should be trended over time to monitor changes in water quality

### Microbial Quality for Water used in Watercress Production

**1. Water must be free from Pathogens**
   - a) Salmonella: absent in 100ml
   - b) E. coli O157: absent in 100ml
   - c) Listeria monocytogenes: < 100 per 100ml
   - d) Cryptosporidium: absent in 100ml

**2. Water must be in specification for indicator organisms**
   - a) Generic E. coli
     - i. Target <10cfu/100ml
     - ii. Acceptable – 10-100 cfu/100ml
     - iii. Unacceptable >100cfu/100ml – (action plan required)

**4.4 Presence of liver flukes in watercress**

- Watercress should only be grown in water of high microbial quality (drinking water standard)
- Watercress production beds should be protected from contamination by animals or animal faeces that could be contaminated by Liver Fluke
- Mud Snails are intermediate hosts. Conditions that encourage mud snails should not be present on site
### 5. Hygiene

#### 5.1 Staff Hygiene

<table>
<thead>
<tr>
<th>Potential Areas of Contamination Risk</th>
<th>Examples of Actions that could be Implemented on Action Plan</th>
</tr>
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</table>
| Staff not effectively trained in basic hygiene standards – such as return to work after ill health | - All workers should understand that the hygiene rules  
- All visitors on site must be made aware and follow hygiene guidelines  
- Policy and training records in place  
- Workers need to be actively encouraged to take responsibility for declaring that they are not fit to work  
- Appropriate protective clothing is identified and worn by staff  
- Defined and managed return to work procedures must be in place for staff who have been ill. (Note increasing concern on Virus transfer) |

| Staff facilities either not available or present a risk to crop | Fixed or mobile toilet and hand wash facilities are available and are used by staff  
- Toilets in acceptable condition and routinely cleaned  
- Sufficient provision of toilet numbers for staff  
- Hand-washing station is required for every 10 people working  
- Drinking water available separately from hand washing/toilets  
- Located away from crop production |

#### 5.2 Equipment Hygiene

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<thead>
<tr>
<th>Potential Areas of Contamination Risk</th>
<th>Examples of Actions that could be Implemented on Action Plan</th>
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| Poor design, maintenance and cleaning of equipment could lead to a buildup of pathogens which can cross contaminate the finished product e.g. harvesters, knives, crates etc | Minimum Expectations:  
- There should be a defined written cleaning procedure – which identified appropriate cleaning chemicals and dilutions etc  
- There should be record of staff being trained to implement the cleaning  
- Records of actual cleaning happening  
- On specialist equipment; it might be swab results that verify the cleaning  

Best Practice:  
- In addition to daily cleaning weekly deep cleaning should be in place where equipment can partially be dismantled and belts removed to facilitate effective cleaning  
- Cleaning carried out in designated area outside the field  
- Effectiveness of cleaning verified through environmental swabbing on key surfaces |

### 6. Post Harvest

#### 6.1 Cooling and Storage

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<tr>
<th>Potential Areas of Contamination Risk</th>
<th>Examples of Actions that could be Implemented on Action Plan</th>
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</table>
| Poor chill chain management can facilitate growth or pathogens | Cooling expectations:  
- Crop should be in chill environment within 2 hours of harvest  
- Crop should be at 5°C within 4 hours of harvest |
Certification Bodies

Your routine point of contact with the Scheme is through your Certification Body. Certification Bodies are licensed by Red Tractor to manage membership applications and to carry out assessment and certification against the Standards. The table below shows which Certification Bodies apply to each enterprise.

<table>
<thead>
<tr>
<th>Certification Body</th>
<th>Beef and Lamb</th>
<th>Dairy</th>
<th>Combinable Crops and Sugar Beet</th>
<th>Fresh Produce</th>
<th>Pigs</th>
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