This crop specific module for radish 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:


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 module, particularly David Norman of Fresh Produce Consultancy Ltd.

Front cover image credit: G’s Fresh Ltd.
### ADDITIONAL REQUIREMENTS AGAINST CURRENT STANDARDS

None for this crop module

### CROP SPECIFIC 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>
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<td>Typical nutrition requirements are given in Appendix 1 of the radish module</td>
<td>Records of analysis</td>
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<td>All soils must be sampled before each cropping season and analysed for major elements such as phosphate, potash and magnesium</td>
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<td>CQ.46.b</td>
<td>Field pH test records</td>
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<td>The pH of each field must be established prior to drilling</td>
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GUIDANCE

SITE AND SOIL MANAGEMENT

SOIL TYPE
Radishes grow well on a variety of soil types. Light textured, well-drained peaty or sandy soils generally produce good quality roots that lift easily. Soils with high organic matter or peat content are capable of producing crops that have excellent colour and skin finish. Soils with heavy texture and high clay content are subject to waterlogging and are not suitable and should be avoided. Soils with a high pH will be more susceptible to scab.

CROP ROTATION
As radishes have a very short growing period, several crops can be grown on the same piece of land during one season. However, such intensive cropping can lead to problems in respect of pest and disease carry over. It is essential to have a rotation which avoids building up disease problems such as club root and scab so as long a rotation as the land base permits should be practiced.

ENVIRONMENTAL PROTECTION & CONTAMINATION CONTROL

THE BASIC APPROACH TO CROP PROTECTION
It is important to minimise pesticide application, especially on such a short-term crop as radish. Unlike many crops, there is not a particularly good choice in respect of disease resistant cultivars. Several new cultivars have good resistance to Fusarium but this disease largely only affects the indoor crop.

Good management and planning
Several factors can contribute to good cultural practice, these include the following:

a. Establishing good cultivation techniques, especially in respect of a firm, level well drained seedbed
b. Ensuring nutrient availability though accurate application of major and minor elements in conjunction with soil and leaf tissue analysis
c. Execution of good field hygiene, especially the rapid disposal of trash
d. Maximising the use of available irrigation to promote good germination, assist even and healthy growth and reduce diseases such as scab

e. Establish the need to take corrective action by regular monitoring to thresholds where established. Trained staff should carry this out. The effect of prevailing conditions should also be taken into consideration.

Corrective action

a. Where corrective action is required, additional biological and natural methods of pest and disease control (where available) should be considered first
b. If chemical control is needed, the following points should be considered, whilst ensuring effective control is achieved:
   - Use the least toxic and least persistent product.
   - Use the most selective product to reduce the impact on naturally occurring beneficial organisms.
   - Use the minimum effective dose rate.
   - Use appropriate application methods with effectively maintained equipment, and spot treating wherever possible.

Field margins can provide a reservoir of insect predators and parasites, including ladybird larvae, hoverflies, ground beetles, parasitic wasps etc. Care should be taken to avoid spray drift into these areas.

PEST, DISEASE AND WEED CONTROL

PEST CONTROL

Aphids
Aphids of various species attack radish from time to time. Attacks are more commercially important on bunched radish where leaf quality needs to be retained. It is most important that aphid numbers are monitored frequently as although attacks are usually very light and do not warrant treatment; very occasionally infestations may reach quite serious proportions, so requiring treatment. Light infestations of aphids are usually controlled by natural predators and parasites such as parasitic wasps.

Cabbage root fly (Delia brassicae)
This is by far the most serious pest of radish. Crops can be affected by the larvae of the cabbage root fly from early May until well into the autumn. The roots are damaged and even light attacks can render the product unmarketable.
There are several generations each year and there is often an overlap in the generations which results in most drillings throughout the late spring, summer and autumn being affected. Only very early spring drillings, which are generally covered with protective fleece are unaffected.

On crops that are not covered with fleece or insect proof mesh then insecticides have to be applied at the time of drilling in order to offer effective control of cabbage root fly and to adhere to the harvesting interval for the pesticide.

At the present time, there is no seed treatment recommended for use on radish. However, it is hoped that a seed treatment may become available which should lead a significant reduction in overall chemical application.

**Forecasting:** Traps are available which will selectively catch adult flies. These traps, used in conjunction with the computer prediction model available from Warwick Crop Centre, give reliable information on the development of the next generation of cabbage root fly larvae.

**Cultural control:** A firm, consolidated seedbed will help minimise damage during light attacks. Covering with a fine mesh netting as soon as the radish are drilled will exclude cabbage root flies adults, thus preventing egg-lay and generally give complete control without the use of insecticides. Note: if second crops are drilled following an infected crop then covering will not be effective.

**Chemical control:** Chlorpyrifos, applied to the seedbed immediately after drilling, will generally give a high level of control of cabbage root fly. Note the PHI is 21 days for chlorpyrifos.

**Flea beetles**

During very dry periods some leaf damage may be observed when flea beetles make small holes in the radish leaves. As the crop grows, these holes expand and become more obvious. There is no chemical measure specifically recommended for flea beetle control in radishes. This is usually only important in bunching crops where leaf quality needs to be maintained.

**Cultural control:** Damage from flea beetle can be greatly reduced by keeping the crop moist. The use of a fine mesh thrip netting will greatly reduce the incidence of this pest.

**Chemical control:** Currently there are no approved pesticides specifically recommended for flea beetle control. However, an application of lambda-cyhalothrin when used for cutworms or cabbage stem weevil, will give incidental reduction of this pest.

**Slugs**

Occasional grazing by slugs may take place, especially during damp conditions, although as radish is grown mainly on very light textured or organic soils, slugs are not normally a big problem.

**Cultural control:** Avoid fields where it is suspected there may be a slug problem. Slug traps can be put out prior to drilling to estimate the population. Many slug pellets are damaging to the ground beetles which attack the larvae of cabbage root fly so overall applications of slug pellets are to be avoided. A firm seedbed will also help to reduce damage.

**DISEASE CONTROL**

**Club root (Plasmodiophora brassicae)**

This is a most serious disease of brassicas and radish can be badly affected if the crop is grown in infected soil. The roots become severely distorted and are unsaleable. The fungus can survive in the soil for long periods. Excessive soil moisture and low pH favour infection. There is no chemical control that is effective.

**Cultural control:** Avoid growing on land where there has been a history of the disease or is badly drained. Be aware that raising the pH above 6.5 may help club root control but will also encourage scab.

**Downy mildew (Peronospora parasitica)**

Downy mildew can affect both the foliage and root of radish. It can be extremely serious if conditions favour the disease i.e. during cool, humid periods. Small yellow spots appear on the leaf surface and a white fluffy mould appears on the under surface of the leaves. The spores that wash down from the leaves affect the roots. The root is disfigured by black spotting which renders the root unmarketable.
**Cultural control:** There are no resistant varieties, although some do seem more susceptible than others. Avoid overwatering during warm, still periods because it can encourage the disease. The use of crop covers may encourage the development of downy mildew, remove covers a few days before harvest to allow leaves to dry out.

**Chemical control:** Azoxystrobin and boscalid plus pyraclostrobin may give some incidental reduction of mildew.

**Fusarium** (*Fusarium oxysporum*)
Although this is a disease associated with indoor radish, it may occasionally be seen infecting outdoor radish during hot summers. The lower leaves yellow and affected leaves drop off. In severely affected crops, the radish may lose all their leaves. The disease is known to survive in the soil for several years. There are some resistant varieties available.

**Chemical control:** None.

**Scab** (*Streptomyces scabies*)
This soil-borne fungus is encouraged by soils that have a high pH. Often symptoms appear, close to harvest, and express themselves as whitish grey scale-like spots on the root. As the spots expand, the radish often becomes soft and associated rotting takes place.

**Cultural control:** Avoid over-liming as the fungus thrives in alkaline conditions. Irrigation at the onset of bulbing may help reduce symptoms. Avoid fields with a history of the disease.

**Chemical control:** None.

**White blister** (*Albugo candida*)
Sometimes misleadingly referred to as white rust, this disease affects the foliage and is particularly important on bunched radish. The disease appears as raised white blisters and can spread rapidly from an initial infection. In severe cases, the leaves are distorted.

**Cultural control:** There is no effective cultural control but good crop hygiene after harvest will help reduce the spread of the disease.

**Chemical control:** None, although strobilurin based fungicides, as suggested for mildew may offer some reduction.

**OTHER DISEASES**
There are other diseases which affect radish. These diseases include wirestem (*Rhizoctonia solani*), black root (*Aphanomyces raphani*) and damping-off (*Pythium spp*).

These diseases are often difficult to distinguish from one another without the help of a plant pathologist. Wirestem and damping off tend to be encouraged by damp cool conditions, whereas the development of black root is encouraged by high temperatures.

Good ground cultivations which encourage free rooting and adequate drainage help reduce the risk of these soil borne diseases. Very intensive rotations, especially when accompanied by poor drainage will encourage all three diseases.

**WEED CONTROL**
There are no residual or contact post crop emergent herbicides approved for use in radish. There are pre drilling contact herbicides available and these can be found on LIAISON®. As radish usually outgrows weed competition because it is fast growing it is only usually early in the season when weeds represent a threat to the crop. The problem of early weed competition can often be overcome by using a “stale seed bed” technique.

**APPROVED USES NOT INCLUDED ON THE PRODUCT LABEL**
In many circumstances, particularly for minor crops, product labels do not include all of the approved uses and 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 use in the UK (formerly known as ‘SOLAs’) by crop or product name should yield a results page. A click on the product name should link to a summary of the approval information. Near the bottom of the summary is the specific off-label number (e.g. 0246/09) and this link will open up a pdf of the current EAMU document giving details of the extension of use.
NUTRITION

All soils must be sampled and analysed for major elements such as phosphate, potash and magnesium. Typical nutrition requirements are given in Appendix 1.

It is essential that the pH of each field is established prior to drilling. Liming materials should be applied with extreme care, as over-liming will encourage scab that seriously affects the quality of the finished product. Excessive applications of lime can also ‘lock up’ elements such as manganese, making them unavailable to the plant.

Care should be taken to apply only the minimum amount of nitrogen needed for such a short-term crop. This is especially important where bunched radish is grown, as over application of nitrogen leads to excess top growth, bulb splitting and also encourages leaf diseases such as downy mildew.

It is important to monitor the crops nutritional status throughout its life. This can be readily done by the use of leaf tissue analysis.

IRRIGATION

As the radish crop is often grown on light textured soil types and drilling takes place all through summer, irrigation is frequently needed to facilitate germination: further irrigation may well be required right up to harvest.

Where scab is likely to be a problem, it is important that the crop is not allowed to become dry at bulb initiation, as this will increase the risk of this disease.

Run off during irrigation should be avoided at all times. Boom type irrigators will usually provide the most even and accurate distribution of water and should be used when cropping radish. The use of neutron probes/potentiometers are of little use in the radish crop as the growing cycle is so short and the effective rooting depth is just a few centimeters.
**HARVEST AND STORAGE**

**POST-HARVEST WASHING**

**Preparation for market**

Freshly harvested radishes should be placed in a “soak tank” immediately on reaching the packhouse, after which, they pass on to final washing and rinsing. The washing/grading line should be capable of handling a rapid throughput. The water used for this operation should be of a potable standard. Consideration should be given to cleanliness and conservation of water used for washing harvested produce. The washing area should be separated from the packing line.

**Water supply**

Water can be drawn from the public mains or other satisfactory sources under the Water (Water Quality) Regulations, 1989. Routine microbiological samples of non-mains water should be undertaken. The final rinse water should always be with water of a potable standard.

**Disposal**

Disposal systems should be able to deal with:

a. the volume of liquid waste and its fluctuation,
b. the quality of solids therein, and
c. the polluting nature of dissolved organic matter.

Waste washing water should be disposed of in a manner that avoids pollution of water courses.

There are statutory powers to prevent the pollution of underground water by discharge of effluent. Underground pollution can be traced to land used for disposal of solid or liquid waste. Pollution of streams and water supplies derived from wells, springs and boreholes can lead to action by the Environment Agency or local water company.

Both screening and sedimentation are recommended as methods of separating solids from water.

**Harvesting**

Bunched radishes are normally harvested by hand in the UK. Harvesting in the early morning when the temperature is cooler will often help to preserve shelf life. Pulled loose radishes should not be exposed to hot sun otherwise serious deterioration takes place.

As with bunched radish, radishes destined for pre-packing, whether being harvested by machine or by hand, should be transported to the packhouse as soon as possible after lifting.

Measures should be taken to avoid deterioration and damage of the product during harvesting, washing and storage. Cooling of wash water during the summer months can be helpful.
APPENDIX 1: TYPICAL NUTRITION REQUIREMENT FOR RADISH
REF. RB209 8TH EDITION

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<th>Nutrient (kg/ha)</th>
<th>Soil P, K, Mg Index or SNS Level</th>
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<td>0</td>
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<tr>
<td>Nitrogen</td>
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<td>Phosphate (as P₂O₅)</td>
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<td>Magnesium (as MgO)</td>
<td>150</td>
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<tr>
<td>Magnesium (MgO)</td>
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</table>

Notes: It will not usually be necessary to top up levels of phosphate, potash and magnesium for subsequent crops in the same season. However soil analysis will confirm whether further nutrients are required.

Further top dressings of nitrogen may be required for following crops on the same land. Amounts will vary between 40-75kg/ha according to soil type and time of year, with less being needed during the summer months when soil mineralisation is higher. Too much nitrogen, applied to bunched radish in particular, will encourage excessive top growth and make the plant more susceptible to certain diseases, such as downy mildew and physiological disorders such as root pinking or splitting.
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.

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<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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