Assured Produce

Crop Specific Protocol

PARSNIPS

(CROP ID: 50)

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Control Document No: 00038/08

Acknowledgements

Assured Produce and members of the NFU-Retailer ICM Partnership gratefully acknowledge the contribution of all consultees in the preparation of this protocol, particularly Peter Wright from Peter Wright Consultancy Services and members of the British Carrot Growers Association R&D committee.

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 **"strongly recommended"** (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 **"strongly recommended"** 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

Notes:

Pesticides with ‘Essential Use’ derogations that expired 31 December 2007 can no longer be used or stored.

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 Products containing substances which have been revoked are shown on the PSD website (http://www.pesticides.gov.uk).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:

- the deadline for use of NPE formulations has been extended to 31 August 2008, see http://www.pesticides.gov.uk/approvals.asp?id=2122
- Pesticides with NPE formulations must be used up by 31 August 2008. In many cases products will be replaced by new non-NPE formulations.
- 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.

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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.

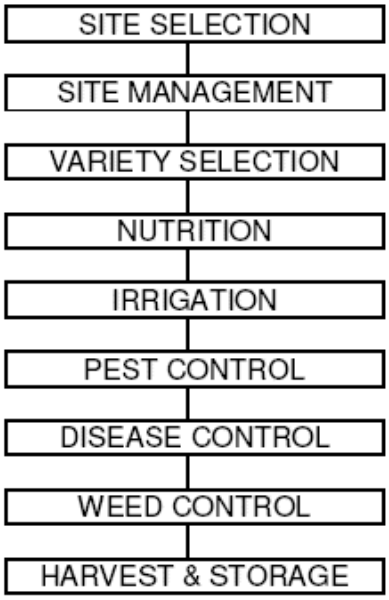
For pesticides on-label, only active substances are shown.

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.

2 Planning and records

See Generic Standards and/or Generic Guidance Notes.

3 Site Selection

3.1 Site history

See Generic Standards and/or Generic Guidance Notes.

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3.2 Crop rotation

(Revised) *Crops are rotated to produce a balanced economic and environmental system of farming and to limit the build up of specific pests, diseases and disorders that adversely affect yield, quality and sustainability.*

In planning crop rotations for Parsnips it is important to recognise that many of the pests and diseases that affect this crop are also encouraged by Carrots, Celery and umbelliferous herbs such as Parsley. Sugar Beet and Potatoes are also important hosts to Violet Root Rot and free-living nematodes that can seriously affect Parsnips and Carrots.

To avoid further build up of Violet Root Rot in root crop rotations, the practice of growing Sugar Beet one year in three or four should be avoided whenever possible.

Crop maturing is closely associated with the incidence of disease. Growers should align drilling periods to intended harvest periods so as to minimise the harvesting of over mature roots that undoubtedly degrade more rapidly and increase the soil pathogen inoculum levels.

A sound policy of rotation is therefore essential for the future of Parsnips and other vegetable and arable root crops.

4 Site management

4.1 Soil mapping

See Generic Standards and/or Generic Guidance Notes.

4.2 Soil management

Soil type

The choice of a suitable soil is an essential requirement for the production of good quality Parsnips. Well-shaped roots will only be obtained if they are able to grow and develop without restriction.

Suitable soils are sandy in texture and range in lightness from pure blowing sand to sandy loams. Silt soils can produce good quality crops but winter access for harvesting and effective soil separation can be extremely difficult in wet conditions. For this reason the heavier silts should be avoided. Fen soils are not preferred for the production of quality Parsnips because of the tendency of organic soils to produce softer roots that are excessively wrinkled and more susceptible to persistent soil diseases.

Stones are a common feature of sandy soils; therefore, mechanical stone separation and burying techniques are often needed to minimise root damage and malformation. Soils with a high content of gravel that cannot be machine separated effectively are not suitable for Parsnips.

4.3 Soil fumigation

See Generic Standards and/or Generic Guidance Notes.

4.4 Substrates

See Generic Standards and/or Generic Guidance Notes.

4.5 Drilling and transplanting

See Generic Standards and/or Generic Guidance Notes.

4.6 Growing systems

4.6.1 Early crops

Crops of Parsnips for harvesting from late June are grown in specific production areas where irrigation can be used in dry periods. First early crops are seeded in the early autumn/winter and the beds are covered in clear film plastic (either as hoops or bed covered) to warm the soil. The film is removed when seedlings are well developed during April or May. The crop should be encouraged to grow quickly through the application of water and nutrients, thereby avoiding any checks to growth.

The drilling population must reflect the variety, seed quality, soil-type, aspect, potential losses and harvest period. In practice, early autumn drilling populations are higher than early spring drillings.

Yields reflect both population and market specification. Early crops tend to have significantly lower yields than maincrop drillings. Early over-wintered crops may suffer from frost lift, leading to an increased level of fanging and therefore marketable quality reduces accordingly.

Early crops rarely require protection from carrot fly and foliar diseases and can, therefore, be grown with minimal pesticide input.

All polythene and fleece crop covers used in early production must be recycled wherever possible.

4.6.2 Main season and late crops

Crops for harvesting from August to April are normally sown during the period February to early June the later sowings being used for spring lifting. Seed selection and placement is improved by using pelleted seed but it is recognised that graded natural seed establishes quicker. Options to prime seed are now readily available. This technique can improve crop uniformity and assist in early weed control.

Main season crops are exposed to all normal pest and disease pressure during growth and development. Regular inspections combined with trapping and forecasting techniques, are used to guide the crop protection programme.

Crops reach marketable size in succession according to variety, drilling date, plant population, site and management aspects. Foliage dies down in the early winter but unlike Carrots, Parsnips are not susceptible to damage from the frosts normally experienced in the UK. To achieve continuity of lifting in frosty conditions some crops are covered in straw, or straw over black polythene, which prevents the soil from freezing around the roots, and also insulates the crop.

It is **strongly recommended** that plastic film materials used as crop covers are recovered and recycled or disposed of at a registered landfill facility.

During the early spring depending on the temperature, crops re-grow strongly producing new foliage and a flowering shoot. As the roots lose condition and become more susceptible to glassiness and spoilage the marketing season naturally ends. This normally occurs during the second part of April except in cooler areas where lifting can be continued for a few further weeks.

Crops covered with a substantial layer of straw, sometimes underlain with black polythene, remain dormant for longer than open crops and help extend the marketing season. Unlike carrots, parsnip spring re-growth is not light dependant and the use of black polythene may hinder harvesting of these very late season crops, as the

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parsnip foliage can grow through the polythene.

It is **strongly recommended** that there is a satisfactory system of crop monitoring undertaken throughout the field storage period.

5 Variety Selection

In choosing varieties of Parsnips, due regard must be paid to the following characteristics:

i. Strength and resistance to bruising.
ii. Tolerance of root and foliar diseases. (Varieties more susceptible to canker and foliar diseases must be avoided.)
iii. Skin and crown quality.
iv. Vigour and habit with relation to their relative programmed use.
v. Spring "bleeding" of sap.
vi. Seed quality - avoid seed lots with high *Itersonilia* and *Alternaria* levels.

6 Nutrition

6.1 Nutrient requirement

(Revised) Major nutrients

Prior to cropping, the field nutrient status should be determined by sampling and analysis. Analysis is required for each field, as fertiliser application must be in accordance with crop need and soil reserves.

Where the soil pH is low (5.8 or below) it will be necessary to apply a liming material in accordance with established practice (RB209).

Examples of typical fertiliser recommendations may be found in Appendix 1.

Phosphate, potash and magnesium blended base fertiliser is normally applied as a soil treatment prior to ploughing, stone separation or bed making. Where dressings of potash exceed 150 kg/ha, the remainder is best applied as a top dressing at 2 - 4 true leaves.

(a) Almost all parsnip production areas are within the revised Nitrate Vulnerable Zones (NVZ's) published. Parsnips are relatively low N users but it is nevertheless important that nitrogen applied is in accordance with crop requirements and large single or excess applications are avoided.

(b) Growers are encouraged to more fully understand crop off-take on their soil types so as to provide evidence in support of total nitrogen applied.

Trace elements

Many sandy soils, particularly where the pH is high, are deficient in trace elements. Deficiencies of manganese and copper are common and are best corrected using specific inorganic trace element foliar sprays. For boron appplication it is appropriate to apply a boronated base fertiliser and/or foliar spray to correct this. Base Boron applications are not suitable on high pH soils.

The crop nutrient status can be readily checked during growth using leaf analysis. This can be a useful guide to the need or otherwise of trace element treatments.

Where trace element and multi-nutrient foliar feeds are used routinely, it is appropriate to demonstrate that such treatments are justified through tissue or other appropriate analysis.

All unnecessary fertiliser and trace element treatments must be identified and avoided.

7 Irrigation

Irrigation response

Adequate soil moisture at seed depth is essential to give satisfactory plant establishment. Conservation of moisture during land preparation and at drilling is essential. Irrigation, as an aid in crop establishment, has proven very beneficial in dry spring conditions. Accurate timing of irrigation for establishment is essential.

Many of the soils used for Parsnip production have low levels of available water. Parsnip roots penetrate deep into the sub-soil and therefore are regarded as very drought tolerant crops.

It should, however, be recognised that soil type and irrigation strategy have a direct effect on skin quality. Heavier soils, or soils under moisture stress, will often have more wrinkled, cream-coloured skin.

The development of earlier crops may be promoted by regular irrigation. Summer crops require regular irrigation to maintain crop continuity and skin quality.

Irrigation scheduling

Scheduling systems help forecast the timing of irrigation and the priority order. A field inspection to examine the soil profile is essential to confirm when the profile is becoming dry and to check on the success of applied irrigation. Capacitance/neutron probes and other soil moisture sensor techniques that give a direct measure of soil water are becoming more widely available and their use is encouraged to maximise irrigation efficiency.

Irrigation water is a scarce resource and it must only be applied in accordance with need.

8 Crop protection

8.1 The basic approach to crop protection

The guiding principle is that pesticide use should be minimised. An integrated approach should be adopted to achieve this involving the following management steps.

Planning:

a. *Sensible crop rotations to avoid build-up of problems.*
b. *Careful site selection to avoid potential or previous problems, thereby enhancing crop health and cleanliness.*
c. *Inclusion of resistant varieties in cropping programmes whilst retaining the required quality parameters and eating characteristics.*
d. *Adopt appropriate target populations to avoid over-maturity prior to harvest.*

Cultural preventative techniques:

a. *Good crop and field hygiene.*
b. *Promoting crop health by ensuring effective nutrient availability through soil analysis and accurate application of fertilisers and trace elements.*
c. *Utilising available irrigation to promote healthy growth and as a control measure wherever appropriate and feasible.*
d. *Volunteer Carrots and Parsnips on "Set Aside" and waste ground provide a dangerous source of pests and diseases and must be effectively controlled.*
e. *Exploit drilling periods that minimise pest risk.*

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f. *Consider crop covers to minimise pest attack.*
g. *Consider opportunities to control/minimise weed pressure/pest and/or disease pressure within the rotation - prior to Parsnip cropping.*

Corrective action

Where corrective or protective action is necessary the following approach should be adopted:

a. Only purchase seed of an acceptable health standard.
b. Establish the need to take corrective or protective action by regular monitoring and referring to established thresholds. Consider the effect of prevailing and predicted weather conditions on the need for treatments.
c. Consider the availability and use of biological and natural methods of pest and disease control.
d. Where chemical control is essential:

- Select the least toxic and persistent product which will provide control with due respect to its efficacy and ecotoxicity.
- Use the minimum effective dose.
- It is **strongly recommended** that seed treatments are considered as a first line of defence against seed borne diseases and pests.
- Use an appropriate application method with effectively maintained equipment.
- Use selective and spot treatments whenever appropriate.
- Time the treatment accurately. *Spray applications which are not justifiable, must be avoided* .
- Formulate an anti-resistant strategy wherever approvals allow.

8.2 Plant protection product choice

See Generic Standards and/or Generic Guidance Notes.

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: information@psd.defra.gsi.gov.uk tel. 01904 455 775

8.3 Advice on the use of pesticides

See Generic Standards and/or Generic Guidance Notes.

8.4 Application of pesticides

See Generic Standards and/or Generic Guidance Notes

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.

(Revised) The key targets are:

- **Utilising combinations of pre-emergent herbicides. With the loss of key herbicides at the end of 2007 this may not always be possible**
- **Optimising late application of fungicides 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**

See Appendix 9 for the pesticide targets and guidelines on this crop.

8.10 Pest, disease and weed control

See Generic Standards and/or Generic Guidance Notes.

8.10.1 Pest control

8.10.1.1 Nematodes

Soil migratory nematodes are widely distributed in sandy soils and can cause severe economic damage to Parsnip crops through direct injury to the seedling taproot causing "fanging" and/or root lesions. For this reason

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most Parsnip crops have been traditionally treated with nematicide at drilling.

Where sampling is undertaken and nematicide justified, a reference untreated area should be left to allow evaluation of the guideline threshold that presently exists. The nematicides currently recommended for use in Parsnips are given in Appendix 2.

8.10.1.2. Carrot fly

Carrot Fly is a widely distributed and serious pest of Parsnips and treatments for its control account for most of the insecticide applied in this crop. The main problem is larval mining of the swollen taproots, especially in late-lifted crops. The severity of damage increases from November onwards.

The following can be effective in reducing the intensity of attack:

i. *Do not site new crops adjacent to or following over-wintered Carrot or Parsnip crops.*
ii. *Do not site Parsnips next to last year's Celery crop, as Celery is very attractive to carrot fly.*
iii. *Choose large open/exposed fields (>20ha) to grow maincrop and over-wintered crops .*
iv. *Over-wintered crops should avoid small fields (<10ha), sheltered fields with boundaries of trees, hedgerows and nettle beds.*
v. *Separate early and late crops (including Carrots, Celery and Parsley). A separation between late and early crops of 2km or more would be ideal.*
vi. *Harvest early crops and the headlands of storage crops promptly.*
vii. *Aim for a minimum 5-year rotation.*

Carrot fly forecasting and monitoring

The HDC-funded carrot fly activity forecast is available by subscription to all levy payers and can give useful guidance on regional root fly activity. Field traps are an effective way of monitoring local activity and are more appropriate to individual circumstances. Both systems combined with local knowledge can be applied usefully to assist in the correct use of carrot fly control measures. Professional help is readily available in setting up trapping schemes and in recording and interpretation of results.

(Revised) Chemical control of first generation

It is important to achieve good control of first generation carrot fly as this lessens the second-generation attack and minimises summer damage.

To achieve this, first early (autumn/winter sown under polythene film) crops can be harvested before the carrot fly develops to the root penetration stage, which can occur from early August.

On second early (first open sown) crops a spray treatment for first generation control may be required. This must be timed to coincide with adult carrot fly activity.

For maincrops, from emergence, during the period of detected first generation carrot fly activity, a timely application of a lambda-cyhalothrin insecticide will be required to prevent attack to and loss of seedlings.

Alternatively, tefluthrin (Force®) seed treatment can be used for crops drilled from mid-March and harvested before mid-August. Earlier use of Force® seed treatment is not justified as the tefluthrin persistence would be inadequate to cover the first generation risk period, traditionally from weeks 15 to 27 (subject to area).

The following factors need to be considered in choosing an insecticide for first generation carrot fly:

a. The pest spectrum.

b. The option to adopt tefluthrin seed treatment.
c. A full COSHH assessment.

Chemical control of second generation

Correct timing, particularly of the first treatment of the second generation programme is crucial. This is best determined by carrot fly trapping and may be assisted by the HDC carrot fly forecast.

A full programme of treatments is only required for crops grown in high-pressure carrot fly areas. In all other circumstances a reduced programme of treatments must be used.

Crops, that do not require treatment for second-generation carrot fly, are those harvested before the end of August.

In some seasons, the second generation may extend beyond early October, or even a third generation may appear. Commercial experience suggests that NO treatment for carrot fly is justified from mid-October.

Recommended application rates and number of applications must not be exceeded. Insecticides are to be applied at the appropriate volume as indicated on respective approvals.

Currently approved insecticides for carrot fly control are listed in Appendix 2.

(Revised) Reducing pesticide usage

Non-chemical solutions to carrot fly control in the form of crop covers are available and should be considered for evaluation, although cost is likely to limit use.

Intensive chemical programmes are not needed where there is little pest activity. Correctly sited and managed orange sticky carrot fly traps will provide individual field guidance on incidence levels. Spray programmes should start only at the beginning of carrot fly activity. Where there is little pest pressure, regular sprays to the outer 24 metres of the crop supplemented with peak activity full field sprays will often provide a satisfactory level of control.

Regular monitoring of all crops will provide information that can be used to limit the damage from pest attack.

8.10.1.3 Aphids

Parsnips are hosts to Willow-Parsnip and Willow-Carrot aphids, both of which can transmit mosaic and mottle virus diseases. Migration starts in May to early June to the new season's crops. Other aphid species commonly infest Parsnips and if they are forming active and damaging colonies, treatments will need to be applied.

Aphid warnings

Unless aphids are found to be present in crops, aphicide sprays must not be applied.

Chemical control

A list of currently approved aphicides appears in Appendix 2.

8.10.1.4 Cutworm

Cutworm attacks are common but larval survival and economic damage is mostly confined to light soils and dry seasons. Cutworms may reduce yield on late-drilled crops by severing seedling plants from their taproots but

the most serious effect is on the loss of quality caused when cutworm larvae mine into maturing Parsnips.

Cutworm monitoring

It is not practical to monitor turnip moth eggs or juvenile cutworms on foliage as they are just 1.2-1.3 mm long when they burrow underground.

Monitoring systems for turnip moth (adult cutworm) activity are well developed but turnip moth monitoring alone will not give a guide to correct spray date that is related to the development of the larvae. Spray warnings are based on dynamic models that will show when sensitive crops should be treated.

Routine treatment can be unnecessary or wrongly timed. Regularly irrigated crops often do not require treatment. Producers are urged to seek professional advice in this area.

(Revised) Chemical and biological control of cutworm larvae

Insecticides recommended for control of cutworms in Parsnips are given in Appendix 2.

8.10.1.5 Red Spider Mite

The last few seasons have witnessed a significant increase in summer Red Spider Mite attacks. Infested crops rapidly discolour and 'hot spots' of necrotic leaves become apparent. The Red Spider Mite is a sap feeder and although only just visible to the naked eye is characterised by a fine silky web covering the colony on the leaf under side.

Pyrethroid insecticides provide little control and further investigations are necessary to establish appropriate cultural or insecticidal control of this pest.

8.10.2 Disease control

Cultural techniques are essential to avoid build-up of soil-borne diseases and carry-over of pathogens from crop to crop.

8.10.2.1 Seedling diseases

Damping-off diseases can reduce plant stand particularly in conditions of adverse emergence.

Fungicide seed treatment should be used to limit the development and spread of seed-borne diseases. Effective seed treatments can have a beneficial effect on the reduction of parsnip canker.

Seed treatments are a relatively cheap, effective and the most desirable method of control. Seed known to carry a high Alternaria *or* Itersonilia *count should be washed prior to fungicide dressing.*

8.10.2.2 Root diseases

Black or brown canker

Black canker is a relatively common problem of Parsnips causing dark brown or purplish-black lesions commonly on the shoulder of the root. The organisms causing such cankers are *Itersonilia pastinacae* , *Phoma* spp and *Mycocentrosporaacerina* . Some leaf spotting can also be associated with these diseases. A wide rotation and the choice of more tolerant varieties are useful methods of cultural control.

A reduced level of Black canker has been correlated with washed seed lots.

Differences in varietal tolerances are known.

Recently, *Fusarium* spp have also been associated with black scab lesions and rot lesions on the crowns of parsnips.

Orange brown canker

The cause of orange brown canker has not been fully identified. In common with black canker it is more prevalent in short rotations. Early lesions are small and usually elliptical. The edge of the lesion is often raised and cracked. Eventually the lesions enlarge and darken. This disease /disease complex can affect early and late crops.

Cylindrocarpon destructans

The soil-borne fungus *Cylindrocarpon destructans* is generally regarded as a weak pathogen but has been shown to produce black brown canker lesions with orange flecks. They have been frequently found in small reddish brown spots and other small lesions on parsnip roots. Root damage predisposes root invasion by *Clyindrocarpon.*

Carrot Fly

Carrot Fly (*Psila rosae*) is a major pest of parsnips and badly affected roots have numerous mines and tunnels. These are often reddish brown in colour and may act as sites of secondary fungal attack.

Cavity Spot remains a major problem in many parsnip-growing areas, particularly in late lifted crops and in wet seasons. Infection pressure appears to increase with frequency of cropping. It can occur on soils not previously cropped with Parsnips or related crops, so previous cropping is not an infallible guide to risk.

There has been scientific debate as to the exact cause of cavity spot in parsnips but most growers believe it to be the same organisms as cause cavity spot in carrots.

Partial control of the main causal organism in carrots (*Pythium Violae)* is possible with metalaxyl-M applied as a soil fungicide at drilling or within six weeks of sowing. Commercial experience indicates application at 1 TL for optimum efficacy.

A soil ELISA test can provide an indication of site cavity spot risk, both before and during the growing season. This test is available commercially and producers are urged to continue to evaluate the usefulness of this test in their own circumstances and to monitor and record the incidence and control of cavity spot in fields in which the soil test has been used.

The incidence of cavity spot increases in lower pH soils, on land recently manured, in wet growing seasons or in over-matures crops. Work at HRI Wellesbourne suggests that free Ca2+, applied at drilling, significantly reduces the incidence of cavity spot. This has not been fully validated and growers must be aware that any calcium product that increases localised soil pH will also increase the risk of scab!

Rhizoctonia

Rhizoctonia solani occurs in most soils and appear to be capable of causing coarse black scarring especially on the crown of the root. Incubation of affected roots in a moist chamber quickly reveals mycelial growth of *Rhizoctonia solani* . Small warty patches on the crown or sides of the root may be caused by scab as in other root crops. Parsnip roots may also carry sclerotia (resting bodies) of *Rhizoctonia solani* , identical to black scurf on potatoes and other root crops. The 'black scurf' is superficial and can be scraped off, but may resist normal root washing procedures. *Rhizoctonia* also produces spores on a characteristic white collar on the petioles just above soil level though this phase does not cause rotting of the underlying tissue.

Splitting and Fanging

Splitting of the periderm or cracking because of uneven growing conditions can lead to substantial increases in fungal attack. Fanging symptoms may be due to pest, disease or soil factors. The relative importance of these factors varies from site to site, as does the distribution of the problem in the field. It is generally agreed that symptoms of secondary root proliferation are due to damage to the taproot at the seedling stage.

Violet root rot*(Helicobasidium purpureum)*

Avoidance of sites where there is any history of this disease is the only control measure currently available. Carrots and many arable root crops are also susceptible (see Section 3.1).

Common scab *(Streptomyces scabies)*

Scab is less common on parsnips compared to carrots but it can occur on parsnips grown on coarse sandy soils of high pH. It can also occur on other soil types in seasons when the early summer period is dry. The root appears susceptible to infection at the seedling stage and well-timed light irrigation can provide some control. Scab lesions darken and enlarge with age and can become infected with secondary bacteria. Severe scab causes wastage and must be avoided

8.10.2.3 Foliar diseases

Downy Mildew

Downy mildew (*Plasmorpara nivea)* occurs much more spasmodically than powdery mildew but can cause extensive yellowing and necrosis of the leaves. Symptoms of the two diseases may be confused but downy mildew generally first develops on the underside of the leaf and causes yellowing of the upper surface in more angular patches delimited by veins in the leaf. The white fungal growth is composed of numerous erect spore stalks, which collapse under dry conditions. The yellow blotches turn brown with age and hasten death of the foliage.

Phoma

Conspicuous pale or reddish brown spots with a deep purple margin are likely to be caused by *Phomopsis diachenii.* A scattering of small black fruiting bodies (pycnidia are often distinguishable within the leaf spots. Whilst *Phomopsis* has not been of economic importance to date, there is increasing concern about the closely related Phoma leaf spot (*Phoma complanata)* , which has caused severe foliar damage particularly in North America. Phoma initially causes small brown spots up to 1mm in diameter, which have yellow haloes. Foliage blight develops if the spots start to merge. Brown spots on the petiole darken with age and cause characteristic crooking over of the leaves. Leaf symptoms have not been prominent in the UK but may be overlooked, as Phoma root cankers are common.

Powdery mildew*(Erisyphe heraclei)*

Powdery mildew is the most common foliar disease of Parsnips. Yield may be reduced following early severe attack. Fungicides are best applied at the first sign of mildew attack when lesions can be clearly identified in the lower foliage often on the petiole. Repeat treatments may be necessary on late crops.

Avoidance of moisture stress will provide partial control. Routine fungicide treatments are not usually necessary and must be avoided if possible. Varieties differ in their tolerance.

Sclerotinia

Sclerotinia will attack parsnip foliage and can progress into the crown of the root to cause a root rot. Crops

which have very vigorous foliage are the most susceptible to attack. Avoidance of conditions, which lead to excessive foliage growth, will limit the incidence of *Sclerotinia* . There are no approved fungicide treatments for Parsnips effective on this disease.

Leaf spot

Leaf spot caused by *Ramularia pastinacae* is common in wetter seasons in Parsnips. Unless significant leaf attack is present control measures are not justified.

No fungicides are specifically approved for the control of *Ramularia* .

Geosporum has been increasingly noted in recent seasons

Phleospora heraclei

This disease has occurred sporadically in East Anglia. The disease tends to be localised initially and can then spread rapidly through the field. The disease is typified by small white spots occurring on the leaves, which become 'shot holed', with leaf death occurring shortly after. Young actively growing leaves tend to be attacked first, making this disease particularly destructive.

Currently approved fungicides are listed in Appendix 3.

Parsnip Yellow Fleck Virus

The parsnip yellow fleck virus is spread by aphid activity within the crop. Infestations are spread sporadically throughout the field

Infected plants have mottled, yellow-flecked or pure yellow leaves, often twisted and stunted. Unlike carrots, attack does not normally lead to plant death.

With the loss of O.P. insecticides aphids are more commonly colonising in crops and therefore routine field inspections and prompt treatment are essential.

Other leaf disorders caused by diseases, pest, etc.

Two of the fungi responsible for black cankers are also capable of causing foliar symptoms. *Itersonilia pastinacae* can cause small pale green or water-soaked flecks, which may have a paler halo. These flecks turn brown and merge to give more general leaf necrosis. *Mycocentrospora acerina* is capable of producing water-soaked or necrotic lesions on parsnips and many other host plant species. Virus diseases can often be found in parsnips on occasional scattered plants and foliar symptoms are consistent with their names - parsnip mosaic virus. Fine yellow or brown speckling of leaves caused by the two-spotted mite (*Tetranychus urticae)* has been a feature of some crops in recent hot dry summers. Webbing and signs of the mites themselves will be found on the underside of affected leaves. The sudden appearance of scorch or necrotic spotting symptoms on the margins of younger leaves in hot weather may be attributable to spray scorch.

(Revised) 8.10.3 Weed control

Growers are encouraged to adopt and perfect more cultural methods of weed control, to include timely inter-row cultivation and use of selective herbicide treatments where possible.

A balance between herbicide efficacy and persistence must be considered. Repeat 'low-dose' programs and tank mixes are often necessary in order to cover the complete weed spectrum. Later drillings may have the opportunity (depending on soil type and weather) to adopt stale seedbed techniques to minimise the weed pressure. This is particularly effective for the control of fools parsley and mignonette.

With the recent development of sophisticated hoes, mechanical weeding is not only an option but has a definite place within parsnip weed control strategies. Parsnips are highly competitive and their foliage can smother late-germinating weeds. Hoeing is often beneficial just prior to crop canopy closure.

Certain weeds are so closely related to Parsnips that selective chemical control is impossible. Examples such as hemlock and wild carrot can be particularly problematic and must be avoided. Fields containing significant proportions of these weeds must not be cropped with early polythene-covered parsnips, as mechanical control methods are not possible while the crop is covered.

All such weeds emerging through the crop and producing viable flowering shoots must be machine topped, weed wiped or hand pulled to prevent the production of seed and further contamination.

Where weed pressure is low but the species present are important (.e.g. volunteer potatoes) hand weeding or weed wiping should be considered as a priority over overall spray applications. Where the weeds present occupy distinct areas of the field or the sides of the beds, only selective or directed treatment is necessary.

Parsnips are generally grown on soils prone to leaching therefore care must be taken that no herbicides appear as major pollutants of ground water.

Currently approved herbicides are listed in Appendix 4.

9 Harvesting and preparation for market

9.1 Hygiene

See Generic Standards and/or Generic Guidance Notes.

9.2 Post harvest treatments

See Generic Standards and/or Generic Guidance Notes.

9.3 Post harvest washing

Washing

The crop is fresh washed as it is inclined to discolour if held for more than a few hours before washing. If holding is essential then raw material must be kept cool and moist. The introduction of 'polishing' washers has allowed some leeway on the retention time of unwashed parsnips.

It is essential that the washing area allows an efficient and rapid throughput of raw material in order to maintain quality in the final product. It is **strongly recommended** that the washing area is separated from the packing area so that clean and dirty areas are distinct.

All equipment must be well designed and manufactured for minimal damage and ease of cleaning. An efficient in-line hydro cooler will remove much of the field heat and assist in the preservation of freshness and colour.

Parsnips are commonly size graded over diverging or drop roller graders. The larger grades are presented loose and the smaller sizes are tray and pre-packed.

All roots to be marketed must be inspected on a well-lit belt or roller table where defective roots can be removed from the sample. Roots meeting customer's requirements are often trimmed to length before packing.

It is **strongly recommended** that knives are plastic handled with a stainless steel blade and stored safely in a sterilising solution when not in use.

Water supply

Water can be drawn from any source providing its quality is satisfactory under the Water Supply [Water Quality] Regulations, 2000. Microbiologists can advise on suitability and treatment of water supplies. Routine checking of non-mains supplies should be carried out. A final rinse with clean water is essential.

Waste water disposal

Disposal systems must cope with:

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

Large seasonal and day-to-day variations of water quantities for disposal are normal. Adequate provision should be allowed for these and rainfall.

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 wastes and great care is needed to prevent this. Pollution of streams and water supplies derived from wells, springs and boreholes can lead to action by the local water authority (Environment Agency/water company). Screening and sedimentation are two recommended methods of separating solids from water.

Every discharge (except clean roof water), reaching certain tidal and all non-tidal rivers requires the prior approval of the Environment Agency.

Waste solids disposal

Waste vegetable material and soil often carries significant levels of persistent pests and diseases. It is essential, therefore, that solid pack-house and washer waste is not returned to land that is likely to be cropped with root crops.

Water recycling

Effective screening, sedimentation and storage are required where water is to be re-used for washing. Reclamation is likely to require a chlorinating plant.

It is strongly recommended that there is an adequate cleaning and conservation policy for water used for washing (See Generic Standards 9.3.1)

9.4 Harvesting

Parsnip roots are very susceptible to mechanical damage and care is needed to ensure that damage is minimised during harvesting and preparation for market.

Roots soon discolour and are difficult to wash clean if there is undue delay between lifting and washing, although, as noted in Section 9.3, the introduction of 'polishing' washers allows some additional retention time. The process of browning is related to temperature and in the summer in particular a few hours delay is sufficient to cause a considerable loss of whiteness and quality.

Share lifting is used in preference to top lifting so as to minimise crop damage. Every effort must be made to minimise damage whilst avoiding the transportation of excessive soil to the washer. For these reasons there is

now an increasing interest in positive selection harvesters that displace soil and allow hand selection of quality crop, the residue falling back on the field.

It is **strongly recommended** that measures are taken to avoid deterioration and damage of the product during harvesting, washing and storage.

10 Pollution control and waste management

See Generic Standards and/or Generic Guidance Notes.

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 Typical application rates for nutrients (kg/ha)

Major nutrient requirements (kg/ha)

(Extracted from RB209)

Nutrient	Soil Index					
	0	**1**	**2**	**3**	**4**	**4+**
Nitrogen (N) - all soils	150	100	50	nil	nil	nil
Phosphorus (P_2O_5) -all soils	200	150	100	50	nil	nil
Potassium (K_2O) - all soils	300	250	200(2-) 150(2+)	60	nil	nil
Magnesium (MgO) - all soils	150	100	nil	nil	nil	nil

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Appendix 2 Insecticides currently approved for use on Parsnips

Active ingredient[2]	Approved Use	Product Feature	Approval Type	Harvest Interval [1]	LERAP Category	Expiry Date [3]	Hazard Rating	MRL (mg/kg)
Bacillus thuringiensis var kurstaki	cutworms	Insecticidal bacterium	SOLA 0433/07 DiPel® DF	none	none	31.12.13	Not classified as hazardous	None set
carbosulfan	aphids nematodes	systemic carbamate insecticide for control of soil pests	Label	98 days (14 weeks)	none	13.12.08	Harmful Irritant	0.1
cypermethrin	cutworms	contact, stomach acting pyrethroid insecticide	SOLA 1974/07 Toppel 10® SOLA 1943/07 CleanCrop Pyrimet®	none	A	31.08.08	Harmful Flammable Irritant	0.05
deltamethrin	insecticide	Contact and residual acting pyrethroid insecticide	SOLA 1610/07 Bandu® SOLA 1696/07 Decis ® SOLA 1158/07 & 1652/07 Decis Protech® SOLA 1263/07 Delta M 2.5EC® SOLA 1662/07 Pearl Micro® SOLA 1634/07 Clean Crop Decathlon®	21 days	A	01.11.08	Harmful/Toxic Flammable	0.05
lambda-cyhalothrin	Carrot fly	quick acting contact and ingested pyrethroid insecticide	Label	14 days	B	13.11.09	Harmful	0.02
lambda-cyhalothrin + pirimicarb	Cutworms, aphids	An insecticide mixture combining translaminar, contact, fumigant and stomach activity	SOLA 0639/06 Dovetail®	14 days	A	31.01.12	Harmful Flammable	0.02 (lambda-cyhalothrin)
nicotine	aphids, caterpillars & insect pests	general purpose, non-persistent, contact alkaloid insecticide	Label	2 days	none	31.12.13	Very toxic **Part II Poisons**	none set
oxamyl	Nematodes	systemic oxime carbamate nematicide and insecticide	Label	Before drilling, 84 days (12 weeks)	None	31.12.13	Toxic	0.01
pirimicarb	aphids	carbamate insecticide	Label	3 days	none	MAPP 09568 31.01.08 MAPP 12910&13644 31.01.12 all others 31.12.13	Toxic	none set

Notes : [1]

Appendix 3 Fungicides currently approved for use on Parsnips

Active ingredient[2]	Approved Use	Product Feature	Approval Type	Harvest Interval [1]	LERAP Category	Expiry Date[3]	Hazard Rating	MRL (mg/kg)
azoxystrobin	*Alternaria, Powdery mildew*	Systemic translaminar and protectant strobilurin fungicide	SOLA 1721/06 Amistar®	10 days	B	31.12.11	Harmful Irritant	0.2
Azoxystrobin + difenoconazole	*Alternaria, Powdery mildew*	Systemic, protective and curative fungicide	SOLA 1476/06 Amistar Top®	14 days	none	31.12.13[a]	Harmful	0.2 (azoxystrobin)
boscalid + pyraclostrobin	*Sclerotinia*	protectant and systemic fungicide	SOLA 1317/05 Signum	14 days	B	30.09.13	Harmful	0.5 (boscalid) 0.3[C] to 14.06.08 (pyraclostrobin)
fenpropimorph	*Alternaria* Powdery Mildew, Crown rot	contact and systemic morpholine fungicide	SOLA 3753/02 Corbel® SOLA 3767/02 Cleancrop Fenpro® SOLA 0629/04 Cleancrop Fenpropimorph®	28 days	none	31.12.13[a]	Harmful	0.05
iprodione + thiophanate-methyl	*Alternaria* Crown Rot	systemic /protectant fungicide	SOLA 0525/04 Compass® SOLA 1969/07 Snooker®	28 days	none	SOLA 1969/07 31.08.08 SOLA 0525/04 31.12.13[a]	Harmful	0.5 (iprodione) 0.1 (thiophanate-methyl)
metalaxyl-M	Cavity spot	systemic, phenylamide fungicide	SOLA 1508/05 SL567A®	6 weeks after drilling	none	30.09.12	Harmful	0.1
sulphur	Powdery mildew	inorganic protectant fungicide, foliar feed and acaricide	SOLA 3654/02 Thiovit Jet® SOLA 2242/07 SOLFA WG® SOLA 2026/07 Microthiol Special®	Apply before end September	none	31.12.13	None stated	none set
tebuconazole	Powdery mildew	systemic conazole fungicide	Label	21 days	none	31.12.13[a]	Harmful	none set
tebuconazole + trifloxystrobin	*Alternaria, Sclerotinia,* Powdery mildew	protectant and systemic fungicide	SOLA 4163/06 Nativo 75WG®	21 days	none	31.12.13	Harmful	0.04 (trifloxystrobin)

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Appendix 4 Herbicides currently approved for use on Parsnips

Active ingredient[2]	Approved Use	Product Feature	Approval Type	Harvest Interval [1]	LERAP Category	Expiry Date[3]	Hazard Rating	MRL (mg/kg)
chlorpropham	annual grasses broad leaved weeds	residual carbamate herbicide	SOLA 1949/07 Comrade®	pre-emergence	none	31.08.08	Harmful Flammable	0.05
cycloxydim **	V. cereals, cover crops perennial / annual grasses	translocated post-emergence oxime herbicide	Label	42 days (6 weeks)	none	MAPP 11769, 10197, 11460 and 08830, 06891 31.08,08 all others 31.12.13	Harmful Irritant	none set
fluazifop-P-butyl **	annual & perennial grass weeds	phenoxypropionic acid herbicide	SOLA 2231/04 Fusilade 250EW® SOLA 2138/03 Fusilade Max®	56 days (8 weeks)	none	31.12.13[a]	Harmful	none set
isoxaben	annual dicotyledons General broad leaved weed control	soil acting amide herbicide (for use on temporarily protected crops)	SOLA 0855/94 Flexidor 125® SOLA 0892/05 Flexidor 125®	pre-emergence (114 days)	none	31.12.13[a]	none stated	none set
linuron	annual meadow grass broad leaf weeds	contact and residual urea herbicide	Label	pre/post-emergence	B	31.12.08	Harmful/Toxic	0.2
metamitron	broad leaf weeds	contact and residual triazinone herbicide	SOLA 1637/06 Goltix WG® SOLA 0513/07 Goltix Flowable®	pre-emergence	none	31.12.13	Harmful	none set
paraquat	grass weeds & broad leaf weeds	non selective, non-residual, contact, bipyridilium herbicide	Label	pre-drilling/ pre-emergence	none	MAPP 11485, 12001, 11988, 10532, 11.07.08 MAPP 11210, 11876, 11646, 10526 11.08.08 MAPP 09951 31.12.13	Toxic	0.02
pendimethalin	annual grasses & broad leaf weeds	residual dinitroaniline herbicide	Label	pre-emergence	B	MAPP 10864 and 10729 31.08.08 MAPP 13355, 12665, 12214, 11217, 12864, 11779, 11778, 12095, 12420, 11781, 11777 31.12.08, MAPP 13815, 13816 18.11.11 all others 31.12.13	Toxic/Harmful Flammable	0.2

Notes: [1] or latest time of application

Appendix 4 Herbicides currently approved for use on Parsnips (Cont'd)

Active ingredient[2]	Approved Use	Product Feature	Approval Type	Harvest Interval [1]	LERAP Category	Expiry Date[3]	Hazard Rating	MRL (mg/kg)
propaquizafop**	V. cereals, cover crops perennials/annual grasses	phenoxyalkanoic acid foliar acting herbicide	Label	28 days (4 weeks)	none	31.12.13	Irritant	none set
prosulfocarb	broad leaved weeds, grasses	thiocarbamate herbicide	SOLA 3774/07	84 days (12 weeks)	B	31.12.13	Irritant	none set
tepraloxydim**	annual and perennial grasses and volunteer cereals	Systemic post-emergence herbicide	SOLA 4023/06 Aramo®	21 days	none	31/05/15	Harmful	0.5[c]
trifluralin	germinating broad-leaved weeds. annual grasses.	soil incorporated dinitroaniline herbicide	Label	pre-sowing	none	MAPP 07406, 07571, 05817, 07947, 11400 31.08.08 all others 20.03.09	Harmful Irritant	none set

Notes: [1] or latest time of application

Metribuzin has a SOLA. This product may cause crop failure, severe crop damage or crop death

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Appendix 5 Seed treatments currently approved for use on Parsnips

Active ingredient (2)	Approved Use	Product Feature	Approval Type	Harvest Interval (1)	LERAP Category	Expiry Date(3)	Hazard Rating	MRL (mg/kg)
cymoxanil/ fludioxonil/ metalaxyl-M	seed treatment	fungicide seed dressing	SOLA 1191/02 Wakil XL®	Pre-drilling	none	31.12.13[a]	none stated	0.1 (Metalaxyl-M)
tefluthrin	Seed treatment	Soil acting pyrethroid insecticide seed treatment	SOLA 0534/04 Force ST® SOLA 0547/05 Force ST®	before drilling	None	31.12.13[a]	Harmful	None set

Appendix 6 Pest control currently approved for use on Parsnips

Active ingredient (2)	Approved Use	Product Feature	Approval Type	Harvest Interval (1)	LERAP Category	Expiry Date(3)	Hazard Rating	MRL (mg/kg)
aluminium ammonium sulphate	birds and mammals	inorganic bird and animal repellent	Label SOLA 1567/06 Guardsman M®	none stated	none	31.12.13 SOLA 31.12.08	none stated	none set

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Appendix 7 Growth suppressant currently approved for use on Parsnips

Active Ingredient[2]	Approved Use	Product Feature	Approval Type	Harvest Interval [1]	LERAP Category	Expiry Date [3]	Hazard Rating	MRL (mg/kg)
maleic hydrazide	growth suppressant	A pyridazinone growth regulator	SOLA 1127/01 Fazor® SOLA 2159/01 Fazor® SOLA 0785/03 Cleancrop Malahide® SOLA 2251/07 Source II® SOLA 2703/07 Fazor®	21 days	none	SOLA 1127/01 2159/01 0785/03 2251/07 31.12.08 SOLA 2703/07 31.12.13	none stated	30

Notes:

[1] or latest time of application

[2,3] not all products containing the listed active ingredients may have approval for parsnips. Where it is stated in the 'expiry' column 'all others' in relation to MAPP numbers, this applies to products with approval for use on parsnips

[a] from PSD website 'For certain approvals granted under COPR, the final "back-stop" expiry date has been extended from December 2008 to December 2013. For these COPR Approvals, whilst the final expiry date is shown as 2013, this may not be reflected in the last available notice. This is because the extension to the expiry date was issued as a blanket amendment, as explained in Regulatory Update 13 of 2006'

[c] UK temporary MRL

** Amendments to the Statutory Conditions of Use of Grass Weed Herbicides containing Acetyl Coenzyme A Carboxylase (ACCase) and Acetolactate Synthase (ALS) inhibitors have been introduced to try and reduce the risk of grass weed resistance. The new restrictions came into effect from 9 October 2006 and must be observed, regardless of label conditions of use. The amendments stipulate only one application per crop of any one active substance which is an ACCase inhibitor. Products containing an ACCase inhibitor cannot be applied more than twice to a crop (the two products must contain a different active substance). Full details can be found on the PSD website: http://www.pesticides.gov.uk/approvals.asp?id=1960

Appendix 8 Guidelines on minimising pesticide residues

These guidelines have been produced after consultation between crop stakeholders and the Assured Produce crop author. They will be developed over the coming seasons as knowledge on minimising residues develops. Growers should consult with their crop protection adviser to ensure other best practices are not compromised before considering these guidelines. The table below lists the active ingredients that may give rise to crop residues and details alternative strategies.

Active Ingredient	**Target: pest, weed, disease**	**Suggested guidelines.**
tebuconazole	Phoma, canker	Ensure clean seed is used. Adopt fungicide mixtures to reduce rates of higher-risk actives. Employ tebuconazole during the earlier stages of crop growth Modify husbandry to minimise disease risk: • Review row configurations. • Match variety, drilling and harvest period to minimise over-maturity. • Closer management of nitrogen to avoid excessive foliage development. • Closer management of irrigation to avoid excessive foliage development. • Maximise rotation interval.
pendimethalin	Pre-emergent herbicide	Use less than the maximum approved rate in combination with other pre-emergent herbicides

The author's review of historical and potential pesticide residues in parsnips identified a low risk of residue. The active ingredients that can leave detectable residues (all consistently below the MRLs) are tebuconazole and pendimethalin. These values may be further reduced through closer attention to: operator training; sprayer maintenance; calibration; and increasing respective harvest intervals etc. In the short term, in consideration of tebuconazole, growers may also wish to consider: adopting disease free seed; improved fungicide timings with disease prediction; fungicide mixes to allow reduced rates and cultural controls (i.e. choosing varieties with disease tolerances and erect foliage, reviewing row configurations, matching drilling timings with populations to minimise over maturity, and closer nitrogen and irrigation management).

The loss of a number of herbicides at the end of 2007 makes reduced rate usage of pendimethalin less of an option.

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Appendix 9 Control Points: Parsnips

CS.50 **PARSNIPS**

CS.50.1 You should implement a satisfactory system of crop monitoring throughout the field storage period - Protocol reference: Section 4.6.2

CS.50.3 You should ensure that plastic film materials used as crop covers are recovered and recycled or disposed of in an appropriate manner - Protocol reference: Section 4.6.2

CS.50.4 *Deleted 2005*

CS.50.5 Measures should be taken to avoid deterioration and damage of the product during harvesting, washing and storing - Protocol reference: Section 9.4

CS.50.6 The washing area should be separate from the packing area - Protocol reference: Section 9.3

CS.50.7 When packing, the knives used should be made of stainless steel blades and plastic handles and stored in sterilising solution - Protocol reference: Section 9.3

CS.50.8 *Deleted 2006*