



Assured Produce

Crop Specific Protocol

ASPARAGUS

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Preface

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

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

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

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

All statements in this protocol containing the words "**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

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

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

Notes:

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 Products containing substances which have been revoked are shown on the PSD website (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.

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.

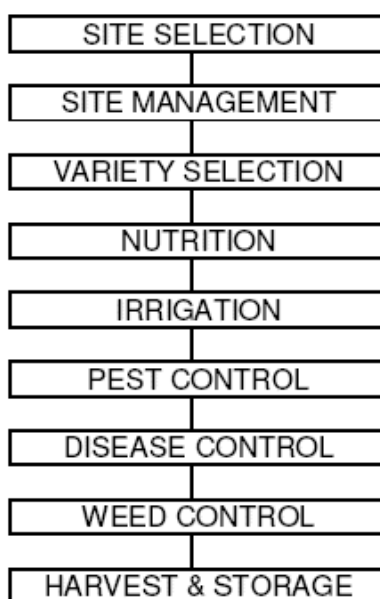
For pesticides on-label, only active substances are shown.

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

Sites which are not prone to frost and are well sheltered from wind are preferred for Asparagus production. Frost will damage the new spear growth in the spring which can result in the crop being out of production for up to seven days and also cause premature fern death in the Autumn. Winds can damage the crop in two ways by:

- a) bending spears during the harvesting season with a consequential loss in quality; and
- b) breaking fern growth later in the year resulting in a loss of photosynthetic potential.

Ideally sites should be flat to avoid soil erosion or should be on a slight south facing slope.

A wide range of soils are suitable for Asparagus growing including loamy sand, sandy loam, loam, silty loam, sandy silt loam, silt, sandy clay loam and silty clay loam. Very heavy clay soils are generally unsuitable due to poor aeration and drainage problems.

In all cases avoid soils which are poorly drained or with a high water table. Waterlogging in winter increases the spread of soil borne diseases particularly *Fusarium* wilt (*Fusarium oxysporum* f. sp. *asparagi*) and *Phytophthora* crown and spear rot (*Phytophthora megasperma*). Waterlogging in itself provides anaerobic conditions unsuitable for Asparagus roots and is likely to cause significant root death. This problem can be overcome on many sites with adequate field drainage.

Some sandy soils are prone to slumping and compaction after wet weather and also after the long harvesting season (up to 2 months) when the crop could have been walked through up to fifty times.

The window for soil cultivations in an established crop is very narrow and on heavier soils care should be taken to make optimum use of this window i.e. when soil moisture conditions are ideal for operations such as fern removal in the autumn or winter and soil ridging over the crowns in autumn, winter or spring. Cultivations in dry conditions can result in slumping or capping of the soil surface if rainfall occurs soon afterwards. Soil smearing and compaction can occur if cultivation is carried out on wet soils.

3.1 Site history

Previous cropping should be considered when siting new plantations of Asparagus.

Where carrots, potatoes and parsnips have been grown there is always the risk that violet root rot (*Helicobasidium purpureum*) may have infected these crops. Asparagus can be affected by violet root rot. Similarly if infected waste root crops that have been fed to cattle, the disease can pass through the animals alimentary system. Any resulting manure will then be infected and if spread prior to planting Asparagus can cause problems later. Sites known to be affected with violet root rot should be avoided.

Planting crowns or container raised transplants are accepted as the most satisfactory ways of successfully establishing asparagus crops. Direct drilling of the crop where it is to be grown for a number of years is not recommended.

3.2 Rotations

It is best to rotate Asparagus crops to prevent the build up of disease problems such as *Fusarium* wilt and *Phytophthora* crown and spear rot. Successfully grown crops should produce economic yields for about 15 years. After removal of the crop, toxins will remain in the soil for some years and replanting should not be contemplated for at least 10 years.

4 Site management

4.1 Soil mapping

See Generic Standards and/or Generic Guidance Notes

4.2 Soil management

See Generic Standards and/or Generic Guidance Notes

4.3 Soil sterilisation

Soil sterilisation has rarely been necessary to date as Asparagus growers are generally able to utilise land virgin to Asparagus. In the future, some growers may find it necessary to re-establish on previously cropped Asparagus land.

It is **strongly recommended** that the soil is only sterilised when there is a known disease risk present. Do not sterilise solely for purposes of weed seed elimination. Formaldehyde, dazomet, metam sodium and steam are currently approved for soil sterilising prior to planting Asparagus, but are unlikely to give complete control of Fusarium and other pathogens which may be deep in the soil profile, and priority should be given to finding clean sites. The use of methyl bromide is forbidden with effect from 1 January 2005.

Fuller details are given in Appendix 1.

With improved application methods other sterilants such as metam sodium and formalin may prove to be perfectly adequate. Therefore growers must assume the responsibility of keeping in touch with new developments, through conferences, workshops and regular contact with advisors.

Before using sterilants, carry out a COSHH assessment as required by law. Consider the risk to the environment, the operator and the subsequent crop. Carry out a cress germination test if required prior to planting.

5 Variety selection

See Generic Standards and/or Generic Guidance Notes

6 Nutrition

A soil analysis should be carried out prior to planting. Samples should be taken to at least 4 depths (0-15 cms, 15-30 cms, 30-45 cms and 45-60 cms) to ascertain accurate levels in the most important rooting area of P, K, Mg and pH. Suitable base dressings should be incorporated pre-planting. Fertiliser recommendations based on ADAS tables can be found in Appendix 2

A maximum total annual application of 150 kg/ha of N should be observed for the established crop. This needs to be split into three equal proportions and applied when the crop can make best use of the nutrient for optimum plant growth i.e. pre-harvest (April), at the end of the harvesting period (end June) and during the fern growing period (mid August). In practise the final application is difficult because of the damage often caused when spreading the fertiliser through tall fern growth. As a compromise 100 kg/ha can be applied at the end of the harvesting period.

If the soil pH is below 6.5, lime or magnesium limestone can be incorporated pre-planting to bring the pH up to 6.5. If necessary, part of the lime should be ploughed in and the remainder applied to and worked into the surface.

Where the soil pH is above 7 micronutrient deficiency (e.g. iron and manganese) may occur. Leaf analysis will confirm such problems.

Further soil samples should be taken every 3 years and the appropriate quantity of fertiliser applied each year according to the index.

7 Irrigation

Adequate soil moisture is essential for satisfactory plant establishment, therefore, irrigation is essential when establishing a crop from container-raised transplants planted in June and may be necessary for crops planted as one year old crowns in March.

To make the most efficient use of water it needs to be targeted to the plants. Overhead irrigation is wasteful of water during the establishment phase. Irrigation is best applied using low level tape or pipes over the gulleys into which the plants are establishing. Alternatively a water bowser can be used which directs water in a narrow band over the plants and immediate rooting area.

Irrigation is not usually needed for the established crop. Given satisfactory soil conditions the crop will produce roots a metre or more in depth and should be able to extract adequate moisture even during the fern growing period. However in very dry summers (such as 1975, 1976, 1995 and 2003) irrigation applied during the fern growing period, especially during June, July and August in conjunction with nitrogen top dressing can have a beneficial effect on some of the more moisture sensitive soils. It is important that a continual supply is available throughout a dry period so that moisture levels can be maintained throughout the rooting profile. During the harvesting period little moisture is lost from the young spear growth so irrigation is not needed. Water applied during this phase of the crops life often results in lowering the soil temperature with consequential reduction in productivity.

8 Crop Protection

8.1 The basic approach to crop protection

See Generic Standards and/or Generic Guidance Notes

8.2 Plant protection product choice

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: p.s.d.information@psd.defra.gsi.gov.uk tel. 01904 455775.

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

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

8.10 Pest, disease and weed control

8.10.1 Pest control

8.10.1.1 Introduction

The guiding principle is that pesticide inputs should be minimised through prevention rather than cure. An integrated approach should be adopted to achieve this involving the following management steps.

Good management and planning:

- a. Careful site selection to avoid potential or previous pest problems thereby enhancing plant health.
- b. Sensible crop rotations to avoid build-up of problems.

Cultural preventative techniques:

- a. Good crop and field hygiene, including good weed control.
- b. Promoting crop health by maximising nutrient availability through soil analysis and accurate application to avoid excess.

Corrective action:

If the above fail to prevent or control the pests, the following approach should be adopted:

- a. Establish the need to take corrective action by regular monitoring and referring to thresholds (where established). The effect of prevailing weather conditions should also be considered.
- b. Where corrective action is required, biological and natural methods of pest and disease control, if available, should be considered first.
- c. If chemical control is needed, the following points should be considered, whilst ensuring effective control is achieved.
 - Use the least toxic and persistent product with due respect to its ecotoxicity.
 - Use the product most selective to biological control agents and naturally occurring beneficial organisms.
 - Use the minimum effective dose rate.
 - Use appropriate application methods with effectively maintained equipment, and spot treating wherever possible.
 - It is **strongly recommended** that all spray applications are targeted to the times of maximum effectiveness in controlling pests, diseases and weeds.

8.10.1.2 Cultural control**Site selection**

If direct drilling a crop avoid drilling on sites previously in long term grass leys which are likely to have a high wireworm population.

If possible avoid sites adjacent to large areas of wasteland or woodland where asparagus beetle may hibernate, or damp areas and weedy headlands where slugs may survive and feed.

Trash removal

Careful and thorough trash removal is mainly practised for the control of fungal diseases. However, levels of asparagus beetle (*Crioseris asparagi*) and slugs may be reduced by removing their over-wintering habitat if trash is removed from the crop during the dormant period.

8.10.1.3 Integrated control

Integrated control of pests on Asparagus includes cultural and chemical control. Regular crop monitoring is essential. This should be carried out either by trained farm staff or a qualified adviser at least fortnightly during the growing season for slugs, asparagus beetle and aphids (weekly during hot weather). Monitoring for slugs using tiles and slug bait is recommended.

8.10.1.4 Biological control

At the present time no biological control measures have been developed for use on Asparagus crops.

However, progress on the use of biological control organisms is rapid and it is the responsibility of all growers to remain in touch with these developments and make use of new biological control organisms within an overall integrated pest management system.

8.10.1.5 Chemical control

Chemical control is acceptable provided it is used as part of an integrated pest and disease management programme with cultural and biological methods (when available). Regular monitoring of Asparagus crops

should be undertaken at least fortnightly through the growing season and a written record kept of all observations and any subsequent recommendations.

Insecticides should not be applied prophylactically to Asparagus crops. The presence of a pest must first be established and due regard then given to the procedures laid down in Section 8.10.1.1.

Approved insecticides currently recommended for specific pests are:

Aphids - *nicotine, *rotenone

Asparagus beetle - cypermethrin (off label), *pyrethrins

Bird and animal repellents - *aluminium ammonium phosphate, *ziram

Slugs - *copper sillicate, *ferric phosphate, *metaldehyde

A list of insecticides currently approved for use on Asparagus is given in Appendix 3.

* These insecticides have an approval for Crops General / Vegetable Crops, which are not specific to Asparagus.

8.10.2 Diseases

8.10.2.1 Introduction

The guiding principle is that pesticide inputs should be minimised through prevention rather than cure. An integrated approach should be adopted in order to achieve this involving the following management steps.

Good management and planning:

Careful site selection to avoid known potential or previous problems thereby enhancing plant health, sensible crop rotations to avoid build-up of problems and inclusion of resistant varieties (where applicable) in cropping programmes whilst respecting the need to meet the required quality parameters and eating requirements.

Cultural preventative techniques:

Good crop and field hygiene, maximising nutrient availability to promote crop health through soil analysis and accurate nutrient applications to avoid excess.

Corrective action:

If the above fail to prevent or control the situation, the following approach should be adopted:

- a. Establish the need to take corrective action by regular monitoring and referring to thresholds (where established). The effect of prevailing weather conditions should also be considered.
- b. Where corrective action is required, biological and natural methods (if available) of pest and disease control should be considered first.
- c. If chemical control is needed, the following points should be considered, whilst ensuring effective control is achieved:
 - Use of the least toxic and persistent product.
 - Use of the most selective product to reduce the impact on naturally occurring beneficial organisms.
 - Using appropriate application methods with effectively maintained equipment, and spot treating wherever possible.

8.10.2.2 Cultural control

Site selection

Do not plant on soils known to have high levels of soil-borne disease inoculum present such as fusarium wilt.

Avoid planting on very heavy or poorly drained soils especially those prone to waterlogging during the winter months. The presence of free water increases the spread of *Phytophthora* diseases.

Avoid planting on frost prone sites or very exposed sites. Frost and/or wind damage provide entry points for fungal spores.

Avoid planting on sites surrounded by very high hedges or woodlands or on sites in low lying areas. Each of these factors can encourage high humidities under certain conditions when diseases such as purple spot (*Stemphylium vesicarium*) can develop.

Avoid sites that have grown carrots, potatoes and parsnips known to have been infected with violet root rot (*Helicobasidium purpureum*).

Avoid sites with soils that will dry out very quickly with consequential increase in plant stress which will encourage diseases such as *Fusarium* wilt (*Fusarium oxysporum* f. sp. *asparagi*).

Rotations

Soil borne diseases such as *Fusarium* wilt and *Phytophthora* crown and spear rot are less likely to build up to damaging levels if clean land is used.

Trash removal and soil incorporation

Removal of trash, ie. dead fern growth during late autumn, is a very effective hygiene measure to reduce the levels of inoculum, especially of purple spot (*Stemphylium*).

Any trash remaining on the surface needs to be thoroughly incorporated into the soil during the ridging operations. Burying trash infected with *Stemphylium* spores has the effect of inactivating the spores, which prevents the spread of the disease onto the new spear growth in the following spring.

8.10.2.3 Integrated control

Integrated controls of diseases on Asparagus are limited and include cultural and chemical control. Regular crop monitoring is essential. There are several important guidelines which should be adhered to:

- i. Only use healthy planting material. Plants showing obvious signs of disease should be rejected.
- ii. There are currently no biological control methods available for fungal diseases. However the cultural controls outlined in Section 8.2 should be carefully observed.
- iii. The diseases that seriously infect Asparagus are limited, eg. *Fusarium* wilt, *Phytophthora* crown and spear rot, purple spot and violet root rot. Rust is seldom a serious problem on UK crops although the disease was reported on several crops in 1997.

Some diseases require prophylactic fungicide treatments in order to aid control. Other fungal diseases only require fungicide treatments after the disease has been observed in the crop eg. applications of iprodione at the first sign of *Stemphylium* on fern growth.

- iv. Before applying fungicides ensure that you use the product which is safest to the environment and natural predators as well as being efficacious for the particular disease concerned.

- v. The use of salt (sodium chloride) has been used successfully to control *Fusarium* wilt in the USA. Trials in the UK conducted over a 7 year period have shown yield responses after the application of salt. Salt appears to slow down decline in Asparagus crops.

8.10.2.4 Chemical control

Consider the guidelines laid down in Section 8.10.2.3. Chemicals should only be used as part of an integrated pest and disease management programme. Regular monitoring of Asparagus crops must be undertaken at least fortnightly during the growing season and a written record must be kept of observations made and subsequent recommendations.

If a product is to be used under the term of an existing SOLA the relevant 'notice of approval' must be obtained and read before applying the product. At all other times abide by all label instruction.

Approved fungicides currently recommended for specific diseases are:

Botritis - boscalid/pyraclostrobin (off label), cyprodinil/fludioxonil (off label)

Stemphylium - azoxystrobin, azoxystrobin/difenoconazole (off label), boscalid/pyraclostrobin (off label), cyprodinil/fludioxonil (off label), iprodione (off label), mancozeb (off label)

Rust - azoxystrobin, azoxystrobin/difenoconazole (off label), boscalid/pyraclostrobin (off label), difenoconazole (off label), mancozeb (off label)

Phytophthora - metalaxyl-M (off label)

Viruses - control the aphid vectors

A list of fungicides currently approved for use on Asparagus is given in Appendix 4.

8.10.3 Weed control

Cultural control: Cultivation between the rows, especially during the early phase of crop establishment, is an acceptable method of weed control. Hand weeding between young plants is also acceptable and reduces the risk of damage to crop. Movement of soil when de-ridging and ridging also allows some weeds to be controlled.

During the mature fern stage weeds other than the most vigorous annuals and perennials are often suppressed under the fern canopy.

Chemical Control: Chemical control of weeds using residual and contact herbicides is acceptable. Only a few herbicides are approved for use in Asparagus crops and they must be used to their maximum effect.

It is imperative that perennial weeds are controlled prior to planting the crop. Translocated herbicides are the most suitable for this purpose.

A list of herbicides currently approved is given in Appendix 5. Do not allow herbicides to be unnecessarily leached into ground water.

8.11 Growth regulators

There are no current label recommendations or SOLAs for the use of growth regulators in Asparagus in the UK. No research work has been carried out in the UK and it is considered that they will have little or no value on Asparagus crops now or in the future.

8.12 Post harvest plantation maintenance

At the termination of the harvesting period (generally accepted to be around 21st of June) the crop should be given every opportunity to produce vigorous, good quality fern growth free of pests and diseases as detailed in Sections 7 and 8 and with good control of annual and perennial weeds.

With the onset of frost in the autumn fern growth will be harmed. Dead fern should be removed from the plantation and preferably burnt off site.

9 Harvesting and storage

9.1 Hygiene

See Generic Standards and/or Generic Guidance Notes

Smoking must not be allowed on the Asparagus field. All harvesting staff must be carefully supervised to ensure spears are cut properly and that high standards of personal hygiene are observed. Spears should be kept under shade at the collection point and removed from the field within 45 minutes of cutting.

9.2 Post-harvest treatments

See Generic Standards and/or Generic Guidance Notes

9.3 Post harvest washing

The crop is mostly fresh washed to remove soil particles from the base of the spears. If holding is essential then spears must be kept cool.

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.

The washing area must be 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 hydrocooler may be incorporated which will remove much of the field heat and assist in the preservation of freshness and shelf life.

All spears to be marketed must be inspected on a well lit belt or table where defective spears can be removed from the sample.

Water supply

Water can be drawn from any source providing its quality is satisfactory under the Water Supply [Water Quality] Regulations, 1989. Microbiologists can advise on suitability and treatment of water supplies. Routine checking of non-mains supplies should be carried out.

Waste water disposal

Any soil sediment should be filtered before water disposal.

Water recycling

If water for washing is to be reused, effective screening, sedimentation and storage is required. A chlorinating

plant or other effective purification treatment will be necessary if recycled water is to be used for wash and rinse purposes.

Water used for washing the harvested crop should be used with conservation in mind and must be microbiologically acceptable.

9.4 Crop cooling

It is **strongly recommended** that the Asparagus crop is cooled adequately post harvest to preserve quality and shelf life.

Unless cooled rapidly after harvesting, Asparagus spears will wilt quickly. Therefore any delay between cutting and cooling should be minimised. The spear temperature should be reduced below 5°C as soon as possible after harvest and preferably to 1-2°C. Cooling immediately after harvesting followed by a cool chain distribution systems is the most effective means of preserving quality and shelf life.

There are two main methods of cooling: hydrocooling and forced air cooling, Hydrocooling removes field heat from the crop rapidly and evenly (15 minutes to cool from 16°C to 2°C). Spears cooled in this way, have been found to be more turgid and less fibrous in subsequent shelf life monitoring. The addition of chlorine to the cooling water also reduces the subsequent rotting and development of disease in pre-packed spears.

Forced air cooling provides uniform cooling if the layout of trays is organised properly, but it is a slower method of removing field heat (1-1½ hours to reduce from 16°C to 2°C).

9.5 Cool storage

Optimum holding conditions for Asparagus are 1 to 2°C and a relative humidity of 95%. The Asparagus should be properly cooled prior to placing in the cool store as warm Asparagus can take more than 2 days to cool if it is stacked in the cool room without adequate pre-cooling.

Asparagus is very perishable and should be marketed as quickly as possible. However, it is possible to hold in a cool store at the above temperatures and humidities for a few days. Longer storage periods will result in appreciable loss of shelf life.

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 and safety

See Generic Standards and/or Generic Guidance Notes

13 Conservation

See Generic Standards and/or Generic Guidance Notes

Appendix 1 Soil sterilants currently approved for use pre-planting of Asparagus

	Formaldehyde	Dazomet	Metam sodium	Steam
Rate of use	0.5 l/m ² diluted with 2.5 l water	220/570 kg/ha	400-1000 l/ha	2
Physical form	Liquid	Granules	Liquid	Gas/Liquid
Required soil temperature for treatment	Effective at 0°C	Above 7°C	Above 10°C	Temperature not critical
Application method	Soil drench. Terragator for field scale use	Best applied using specialist applicator	Injected into soil using specialist applicator	Injected into soil using specialist equipment
Requirement for polythene cover after treatment	No cover required	Polythene cover preferred, but surface can be sealed by smearing	Surface sealed after treatment by smearing or rolling	Sheeted at time of treatment
Treatment time to planting	At least 4 weeks	At least 6 weeks	At least 7 weeks	1 day to allow for cooling
Spectrum of activity	Good fungicide and general biocide. Limited effect against weeds and nematodes	Good fungicide. Controls many soil pests, nematodes and weeds	Good control of nematodes, weeds & fungal diseases at higher doses	General biocide
Human toxicity	Toxic if swallowed. Harmful in contact with skin or by inhalation. Operators must observe occupational exposure standard, HSE guidance note ref EH40/90 and ACOP 30	Harmful in contact with skin and if swallowed. Irritating to eyes, skin and resp. system	Irritating to eyes, skin and respiratory system	Handling steam can be dangerous to operators. Must be carried by trained staff.

Note: A low soil temperature means higher fuel cost necessary, more importantly soils should be dry and well drained.

Appendix 2 Typical fertiliser application for Asparagus (kg/ha)

Rates recommended for first 3 years according to an initial soil analysis

1st year before planting

Nutrient (kg/ha)	Soil Index					
	0	1	2	3	4	4+
Nitrogen (N)	50	50	50	nil	nil	nil
Phosphate (P ₂ O ₅)	175	150	125	100	75	nil
Potash (K ₂ O)	250	225	200	150	125	nil

1st year after planting top dressing (July) ⁽¹⁾

Nitrogen (N)	50	50	50	nil	nil	nil
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2nd year base dressing (spring)

Nitrogen (N)	50	50	50	nil	nil	nil
Phosphate (P ₂ O ₅)	100	100	75	75	50	nil
Potash (K ₂ O)	100	50	25	25	nil	nil

Top dressing (June)⁽²⁾

Nitrogen (N)	50	50	50	nil	nil	nil
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3rd year (and annually thereafter) base dressing (spring)

Nitrogen (N)	50	50	50	nil	nil	nil
Phosphate (P ₂ O ₅)	75	75	50	50	25	nil
Potash (K ₂ O)	100	50	25	25	nil	nil

Top dressing (end June)

Nitrogen (N)	50	50	50	nil	nil	nil
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All years on sands and light loams

Magnesium (Mg)	90	60	nil	nil	nil	nil
Magnesium (Mg) other soils	60	30	nil	nil	nil	nil

Notes:

(1) 1st year top dressing: Nitrogen fertiliser should be applied in a 400 mm (16 ins) wide band along the rows. The recommended rate (50 kg/ha) is for each treated hectare of crop, applied within the band.

(2) Subsequent top dressings: Nitrogen fertiliser should be applied at the recommended rate (50 kg/ha) at the end of June. An additional amount of 50 kg/ha nitrogen needs to be applied in the fern growing period (mid August). If for practical reasons e.g. difficulty in moving through the fern is likely to prevent this application then 100 kg/ha can be applied at end June.

Appendix 2 (Cont'd)

Well rotted bulky organic manures can be applied and incorporated to improve soil structure of all soil types and to improve the water holding capacity of light soils. However, bear in mind that these manures contain nutrients and fertiliser applications should be reduced according to the following table for each tonne or cubic metre of material applied.

	N	P ₂ O ₅	K ₂ O	Mg
Farmyard manure (kg/t)	1.5	2.0	4.0	0.8
Undiluted slurry (kg/m ³) ⁽¹⁾				
Cow	1.5	1.0	4.5	0.6
Pig	4.0	2.0	2.7	0.4
Poultry	9.0	5.5	5.5	1.3

Notes:

⁽¹⁾ adjust the values if diluted

Sodium

Asparagus can respond to salt applications. Apply 500 kg/ha Na₂O per year but not until the third year. Apply half of the application in April (pre-harvest) and the remainder at the end of June (post-harvest).

Appendix 3 Insecticides currently approved for use on Asparagus

Active Ingredient	Product Feature	Approval Type	Harvest Interval ⁽¹⁾	LERAP Category ⁽³⁾	Hazard Rating	MRL (mg/kg)
*aluminum ammonium phosphate	Inorganic bird and animal repellent	Label	None stipulated	No buffer zone requirement	None stated	No current MRL
*copper silicate	Molluscicide	Label	None stipulated	No buffer zone requirement	None stated	No current MRL
cypermethrin ⁽²⁾	Synthetic pyrethroid insecticide. Contact and stomach acting. Controls broad spectrum of pests and predators	SOLA	24 hours	A	Harmful	0.1
*ferric phosphate	Molluscicide	Label	None stipulated	No buffer zone requirement	None stated	No current MRL
*metaldehyde	Molluscicide. Mainly kills slugs and snails, but is dangerous to game birds and wild animals	Label	Zero	No buffer zone requirement	Harmful	No current MRL
*nicotine	Alkaloid insecticide. General purpose non-persistent contact insecticide. Dangerous to game birds and wild animals	Label	2 days	No buffer zone requirement	Toxic	No current MRL
*pyrethrins	Non persistent contact acting insecticide	Label	None stipulated	No buffer zone requirement	Harmful Irritant	No current MRL
*rotenone	Natural insecticide. Contact non-persistent insecticide. Can be used in organic production	Label	1 day	No buffer zone requirement	Irritant	No current MRL
*ziram	Bird and animal repellent	Label	56 days stipulated	No buffer zone requirement	Irritant	No current MRL

Notes:

(1) or latest time of application

(2) SOLA - see Appendix 6 for the specific product and expiry date

(3) Consult product label

* These insecticides have approval for Crops General / Vegetable Crops but are not specific to asparagus

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

MRLs expressed as milligrams of residue per kilogramme of food.

Appendix 4 Fungicides currently approved for use on Asparagus

Active Ingredient	Product Feature	Approval Type	Harvest Interval ⁽¹⁾	LERAP Category ⁽³⁾	Hazard Rating	MRL (mg/kg)
azoxystrobin	A systemic translaminar and protectant strobilurin fungicide.	Label	None stipulated	No buffer zone requirement	None stated	0.05
azoxystrobin/ difenoconazole ⁽²⁾	A systemic and protectant fungicide	SOLA	None stipulated	No buffer zone requirement	Irritant	0.05
boscalid/pyraclostrobin ⁽²⁾	A protectant and systemic fungicide mix	SOLA	None stipulated	B	Harmful	No current MRL
cyprodinil/ fludioxonil ⁽²⁾	A systemic fungicide	SOLA	None stipulated	B	None stated	No current MRL
difenoconazole ⁽²⁾	A protective and curative diphenyl ether triazole fungicide.	SOLA	None stipulated	No buffer zone requirement	None stated	No current MRL
iprodione ⁽²⁾	A protectant dicarbaximide fungicide with some eradicant activity.	SOLA	150 days	No buffer zone requirement	Irritant	0.02
mancozeb ⁽²⁾	A protective dithiocarbamate fungicide	SOLA	None stipulated	No buffer zone requirement	Harmful	0.02
metalaxyl-M ⁽²⁾	A phenylamide systemic fungicide	SOLA	7 days after application	No buffer zone requirement	Harmful Irritant	0.05

Notes:

⁽¹⁾ or latest time of application

⁽²⁾ SOLA - see Appendix 6 for the specific product and expiry date

⁽³⁾ Consult product label

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

MRLs expressed as milligrams of residue per kilogramme of food.

Appendix 5 Herbicides currently approved for use on Asparagus

Active Ingredient	Product Feature	Approval Type	Harvest Interval ⁽¹⁾	LERAP Category ⁽³⁾	Hazard Rating	MRL (mg/kg)
clomazone ⁽²⁾	An isoxazolidinone residual herbicide	SOLA	Pre-emergence of seedlings and post harvest of established crops	No buffer zone requirement	Irritant	No current MRL
clopyralid ⁽²⁾	A foliar translocated picolinic herbicide for the control of thistles.	SOLA	After the final harvest of spears and before emergence of fern	No buffer zone requirement	None stated	No current MRL
diuron ⁽²⁾	Soil acting herbicide. Control of a wide range of annual weeds.	SOLA	Pre spear emergence	No buffer zone requirement	Irritant	No current MRL
glyphosate ⁽²⁾	Translocated non residual herbicide for control of annual and perennial weeds, applied post harvest of spears, before new growth at the end of June in year of harvest.	SOLA	See product features	No buffer zone requirement	Harmful Irritant	0.1
isoxaben ⁽²⁾	Soil acting amino herbicide for control of a wide range of annual weeds.	SOLA	Pre-emergence of harvestable crop	No buffer zone requirement	Irritant	No current MRL
linuron ⁽²⁾	A contact and residual herbicide	SOLA	Pre-emergence of spears	B	Irritant	0.05
metamitron ⁽²⁾	Contact and residual triazonone herbicide for control of a range of annual weeds.	SOLA	12 weeks after transplanting	No buffer zone requirement	Irritant	No current MRL
metribuzin ⁽²⁾	Contact and residual triazinone herbicide	SOLA	Whilst crop is dormant in the year of harvest and after the final harvest of the crop.	B	Irritant	No current MRL
pendimethalin ⁽²⁾	A residual dinitroaniline herbicide	SOLA	Application: pre-emergence of the crop and after final harvest of the crop	No buffer zone requirement	Harmful	0.05
triclopyr ⁽²⁾	An aryloxyalkanoic acid herbicide for perennial and woody weed control	SOLA	Spot treatment post harvest of the crop and 8 months before harvest of the next crop	B	Harmful	No current MRL

In addition, paraquat and diquat have an approval for use in all edible crops, which although not specific to Asparagus allows their use pre crop emergence.

Notes:

or latest time of application prior to harvest

⁽²⁾ SOLA - see Appendix 6 for the specific product and expiry date

⁽³⁾ Consult product label

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

Appendix 6 Specific off-label approvals for Asparagus

Number	Product Name	Ingredient	Expiry
0651/06	Afalon ®	linuron	31/12/08
2364/06	Alpha Pendimethalin 330 EC ®	pendimethalin	31/12/08
0831/07	Amistar Top®	azoxystrobin/ difenoconazole	31/12/13
1476/07	Asteroid ®	glyphosate	30/06/12
2113/06	Bunker ®	pendimethalin	31/12/08
0530/06	Centium 360 CS ®	clomazone	31/12/08
0394/03	Cleancrop Metribuzin ®	metribuzin	31/12/08
1943/07	Cleancrop Pyrimet ®	cypermethrin	31/08/08
2948/06	Cleancrop Solmet B ®	metribuzin	31/12/13
3322/07	Cliophar ®	clopyralid	30/04/09
2952/07	Cliophar ®	clopyralid	31/12/13
1493/05	Difcor 250 EC ®	difenoconazole	31/12/08
0381/06	Dithane 945 ®	mancozeb	31/12/08
0390/06	Dithane 945 ® (12545)	mancozeb	31/12/08
2522/07	Diurex 50 SC ®	diuron	13/12/08
0470/05	Dow Shield ®	clopyralid	31/12/08
2318/97	Flexidor 125 ® (05104)	isoxaben	31/12/08
0893/05	Flexidor 125 ®	isoxaben	31/12/08
0658/06	Gamit 36 CS ®	clomazone	31/12/08
1758/04	Goltix WG ®	metamitron	31/12/08
2445/06	Lontrel 200 ®	clopyralid	31/12/13
0737/03	Marquise ®	metamitron	31/12/08
0158/05	Plover ®	difenoconazole	31/12/08
0368/03	Python ®	metribuzin	31/12/08
0358/06	Roundup ® (10317)	glyphosate	01/07/07
2122/04	Roundup Biactive ®	glyphosate	31/12/08
2036/06	Roundup Biactive ®	glyphosate	30/06/12
1928/07	Rovral WP ®	iprodione	31/08/08
1796/07	Rovral WP ®	iprodione	31/12/08
0102/05	Sencorex WG ®	metribuzin	31/12/08
4276/06	Shotput ®	metribuzin	31/12/13
0262/08	Signum ®	boscalid/pyraclostrobin	30/09/13
1502/05	SL567A ®	metalxyl-M	30/09/12
0934/05	Stomp 400 SC ®	pendimethalin	31/12/08
0235/07	Switch ®	cyprodinil/fludioxonil	31/12/13
0530/05	Timbrel ®	triclopyr	31/12/08
1976/07	Toppel 10 ®	cypermethrin	31/12/08
2524/07	Unicrop Flowable Diuron ®	diuron	13/12/08

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

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

Appendix 7 Control Points: Asparagus

CS.42 ASPARAGUS

CS.42.1 All spray applications should be targeted to the times of maximum effectiveness in controlling pests, diseases and weeds.

Protocol reference: Section 8.10.1.1

CS.42.2 Growers should demonstrate soil sterilization is only used where a disease is present.

Protocol reference: Section 4.3

CS.42.3 Growers should cool the crop adequately post harvest to preserve quality and shelf life.

Protocol reference: Section 9.4