



Assured Produce

Crop Specific Protocol

STRAWBERRIES

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 Products containing substances which have been revoked are shown on the PSD website (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

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.

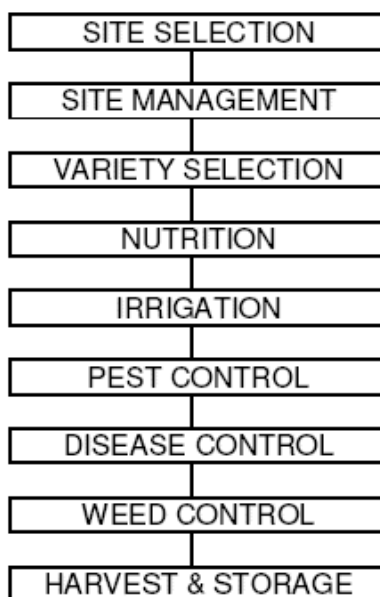
For pesticides on-label, only active substances are shown.

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. Any changes to the text have been highlighted by marking the document with a line in the margin.

2 Planning and records

See Generic Standards and/or Generic Guidance Notes.

3 Site selection

3.1 Site history

Sites, which are not prone to frost, and which have good shelter from wind are preferred for Strawberry production. Both wind and frost damage in the spring can lead to increased fungal disease risk especially *Botrytis* to flowers and fruit, which may necessitate increased fungicide applications.

Where it is planned to cover a Strawberry crop with temporary structures e.g. Spanish or French tunnels, a site should be chosen with good wind protection to prevent removal of polythene by gale force winds.

A wide range of soils are suitable for Strawberry growing including loamy sand, sandy loam, loam, silty loam, sandy silty loam, silt, clay loam and silty clay loam. However, 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 red core (*Phytophthora fragariae*). Waterlogging in itself can cause anaerobic conditions unsuitable for Strawberry roots and is likely to cause significant root death. This problem can be overcome on many sites with adequate field drainage and the use of raised beds.

Some sandy soils are prone to slumping and compaction after wet weather. A high standard of soil cultivation and management is required to alleviate this problem. The use of polythene mulch virtually eliminates the aforementioned risk.

The window for the cultivation of the soil can be very narrow on heavier soils. Care should be taken to make optimum use of the window, ie when soil moisture conditions are ideal to raise a good tilth without compaction, smearing or producing clods of soil.

Avoid the use of soils that have grown Linseed, Flax, Hops, Peas, Runner Beans or Potatoes unless a soil test reveals the level of *Verticillium* wilt to be low.

It is **strongly recommended** that when selecting fields for strawberry production, consideration is given to soil structure, drainage, texture, pH, soil depth, exposure of the site to prevailing winds, susceptibility to spring frosts and endemic soil borne pests and diseases.

3.2 Rotations

Continuous cropping of Strawberries on the same land can lead to a build up of *Verticillium* wilt, crown rot and red core as well as many non-specific disease organisms such as *Pythium*, *Rhizoctonia* and *Phytophthora* diseases. Migratory nematodes, which cause direct feeding, damage, to the roots of strawberry plants e.g. *Pratylenchus penetrans*, or may cause damage and act as virus vectors i.e. *Xiphinema diversicaudatum* and *Longidorus* spp., may also increase to unacceptable numbers where strawberries are grown repeatedly.

Rotating with arable crops including cereals, Oil Seed Rape, grass leys, Maize and vegetables can reduce this risk. However, care should be taken to avoid the planting of crops in the year immediately prior to strawberries, e.g. Maize, where residual herbicide usage is likely to incur the risk of soil residues, potentially very damaging to the following crop. Where adequate land is available to permit the planting of strawberries in rotation with other arable crops, these should not include Linseed, Lucerne, Flax, Hops, Peas, Runner Beans or Potatoes as these are likely to enhance *Verticillium* levels in the soil.

The minimum rotational break should be 3 years following a 3 year crop of Strawberries, or 2 years following a 2 year crop of Strawberries. For annual cropping 3 successive crops can be taken before the planting of a break crop or crops, assuming no disease problems are encountered in the first 2 years. Long rotational breaks of 5 years or more usually provide additional yield benefits and should be considered where it is practical to do so (see Section 8.10.2.2).

3.3 Field siting

'Everbearer' Strawberry varieties tend to be more susceptible to fruit infection by powdery mildew. Although Everest, Evie 2 and Albion are classed as moderately resistant to mildew other cultivars, e.g. Flamenco, are moderately susceptible to this disease.

It is important therefore, to protect 'Everbearers' from this disease to apply a suitable fungicide programme pre-fruiting. The problem can be exacerbated if everbearers are grown next to 'June bearer' varieties of strawberry, especially those i.e. Elsanta which are very susceptible to mildew. Therefore plant 'everbearing' varieties at least 150 metres away from the nearest plantation of 'June bearers'.

Avoid planting new Strawberries of any variety next to an old plantation of Strawberries, especially if high levels of two-spotted spider or tarsonemid mite, vine weevil or mildew are present in the existing plantation (see Section 8.10.1.2).

4 Site management

Extended season production

Under in UK climatic conditions most 'June bearer' strawberry varieties will crop naturally over a period of 3 to 4 weeks and everbearers for 10 to 12 weeks. It is, therefore, necessary to grow a range of varieties and to use a range of production techniques and planting dates to achieve continuous cropping over an extended period. Without providing the crop with heating it is possible to harvest from mid May to late October-early November. With heat it is possible to extend the season still further from early April to late December.

To enable the harvest period to be extended growers provide crops with protection by planting under glass, glasshouses or fixed polythene clad tunnels, or by covering open field grown crops with temporary structures e.g. Spanish or French Tunnels.

Open field grown crops may be covered with floating crop covers to advance or covered whilst they are still dormant in late winter with straw to delay harvest. Planting may be into the soil or into soil-less media, usually comprising of peat or coir, or a hydroponics system of production used. A range of planting material e.g. freshly dug bare root, or cold stored runners, waiting bed or misted tip plants used. Successional batches, of plants of a single e.g. Elsanta, or several June bearing cultivars being planted, in the late winter, spring or autumn and everbearing varieties in the autumn or more usually the early spring to provide as long as possible a harvest period.

Where the strawberry crop is grown under glasshouse, fixed or temporary polythene clad tunnels it is important that all additional operator and crop safety requirements are observed when applying agrochemicals under these structures especially with regards to temperature. It is inadvisable to allow the temperature to rise above 28°C even for short periods. The preferred maximum temperature is 25°C. Venting or the uncovering of crops should be carried out before this temperature is reached. If using floating film under polythene tunnels or double layers of floating film outside, a temperature controlled warning device should be used such as a siren or alarm bell. Additionally if two layers of floating film are used the top layer must be removed during the day once flowers are open. In all cases uncovering or venting is advised to improve pollination when outside temperature is 15°C or above.

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 fumigation

Soil sterilisation should be avoided where the possibility of rotating the cropping exists. It is however accepted that this is not always possible and soil sterilisation may be required. It is strongly recommended that soil

sterilisation is only undertaken where necessary. (See Generic Standard 4.3.2)

Only sterilise the soil when there is a known disease risk present. Do not sterilise solely for purposes of weed seed elimination. The following sterilants are currently approved for use prior to planting Strawberries:

formaldehyde,
dazomet,
metam sodium,
chloropicrin,
1, 3 dichloropropene,
and steam.

Further details are given in Appendix 1.

It is strongly recommended that growers assess the reasons for using any soil sterilant (see Appendix 1). Assuming the responsibility of keeping in touch with new developments as regards the treatment of soil, pre-planting, for pest, disease and weed control through conferences, workshops and regular contact with advisors. (See Generic Standards 4.3.1)

Before using sterilants growers must 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 (see Appendix 1).

4.4 Substrates

Crops in soil-less media

An increasing number of growers now grow Strawberries in soil-less media and in particular peat bags. These bags are either laid on the ground or on a variety of different support systems. In many cases, such crops are covered with Spanish or French tunnels.

When setting up such a plantation, care should be taken to lay out the bags or containers in such a way so as to ensure optimum use of agrochemicals with minimal wastage. Where appropriate, steps must be taken to make the necessary adjustments to spray applicators or to use applicators designated for this crop use alone.

Crops grown on support systems e.g. tabeltops can be more prone to powdery mildew infection. So where this system of production is being used and market requirements permit, tolerant or resistant varieties should be grown to prevent over reliance upon fungicides.

5 Variety selection

5.1 Choice of variety or rootstock

See Generic Standards and/or Generic Guidance Notes.

5.2 Seed quality

See Generic Standards and/or Generic Guidance Notes.

5.3 Seed treatments and dressings

See Generic Standards and/or Generic Guidance Notes.

5.4 Plants and nursery stock

When purchasing strawberry plants, it is strongly recommended that they are of the highest possible health status, preferably certified material and their quality meets the specifications for which they are intended. (See Generic Standards 5.4.2) Similarly plants being raised by growers for their own use should be of the highest health status and preferably certified.

Where growers require assurances from propagators that plants have been raised within the auspices of the Assured Produce Scheme, they should request an Assured Produce verification number from their propagator.

6 Nutrition

6.1 Nutrient requirement

Soil-based crops

A soil analysis must be carried out pre-planning for P, K, Mg and pH levels. Suitable base dressing should be incorporated pre-planting. Typical fertiliser recommendations can be found in Appendix 2.

A maximum annual application of 40 kg/ha of N for 'Junebearers' and a maximum annual application of 80 kg/ha N for 'everbearers' should be observed if applied as a base or top dressing. If applied as fertigation, ie. little and often during the life of the crop, these maximums can be increased by 50% but only if required for optimum plant growth.

Growers must never allow fertigation to take the soil beyond field capacity for any single application otherwise leaching of nutrients is likely to occur.

If soil pH is above 7 induced deficiency of micronutrients particularly of manganese and iron may occur, the routine application of foliar sprays of trace element, being necessary, to overcome the problem.

If soil pH is significantly below 6, lime as ground chalk or magnesium limestone may need to be incorporated into the soil pre-planting to raise the pH up to 6.5. If the soil, is very acidic then part of the lime will need to be applied pre-ploughing of the site so that it can be worked into the soil to depth. Followed by a second application of lime, post ploughing which is worked into the topsoil by the final shallow pre-planting cultivation.

Crops in soil-less media

Nutrition in soil-less growing media should normally be through the trickle irrigation system but use of controlled release fertilisers is also acceptable. The optimum levels of nutrients required, pH and conductivity are well documented for Strawberries. If you are unaware of these seek professional advice.

Crops grown in peat bags or other soil-less substrates require regular management of irrigation and nutrition. It is advisable to monitor the levels of feed being applied to the substrates as well as that draining through the system. Such monitoring should be used in conjunction with foliar analysis to avoid excessive use of nutrient feeds and drainage of high concentration feeds into the soil beneath the bags, troughs or other containers into which the crop has been planted.

7 Irrigation

Adequate soil moisture is essential to give satisfactory plant establishment, even growth and to promote quality, shape, size and yield of fruit. For most soil types in most seasons irrigation is essential for extended season cropping as well as during regrowth post harvest.

Irrigation requirements can be planned using soil moisture monitoring devices such as the neutron probe or

tensiometer. Alternatively a scheduling system can be used to forecast future irrigation requirements.

It is **strongly recommended** that irrigation methods are chosen which avoid damage to the crop during establishment and cropping.

Soil moisture during planting

Roots of Strawberry runners are very susceptible to desiccation and great care should be taken to ensure soil moisture conditions are satisfactory pre-planting especially if planting during the summer. Do not allow the runners themselves to dry out or overheat pre planting.

Establishment

If planting during spring or summer overhead irrigation should be used where possible to wet the leaf tissue and avoid stress on the plant. The establishment phase lasts 10-20 days depending on temperature.

Cropping

If possible use layflat or sub-irrigation during cropping. Avoid excessive overhead watering which could damage fruit or encourage the spread of fungal pathogens such as *Botrytis*, *Colletotrichum* or *Phytophthora*.

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.

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 harvest intervals are followed**
- **Ensuring that application equipment is applying products correctly**

See Appendix 10 for the pesticide targets and guidelines on this crop.

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

- Careful site selection to avoid potential or previous pest problems thereby enhancing plant health.*
- Sensible crop rotations to avoid build-up of problems.*
- Inclusion of resistant varieties in cropping programmes whilst respecting the need to meet the required quality parameters and eating requirements.*

Cultural preventative techniques

- Good crop and field hygiene.*
- Promoting crop health by maximising nutrient availability through soil analysis and accurate application to avoid excess.*
- Utilising irrigation as a control measure wherever appropriate and feasible.*

Corrective action

If the above should 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 the prevailing weather conditions should also be considered.
- b. Where corrective action is required, biological and natural methods of pest and disease control, if available, must be considered first.
- c. If chemical control is needed, the following points must 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.

8.10.1.2 Cultural control

Site selection

Avoid planting on soils known to be infested with vine weevil or adjacent to crops such as blackcurrants, raspberries, blackberries or other strawberry crops, where the presence of this pest has been confirmed. .

If possible avoid sites adjacent to large areas of wasteland or set-aside land where thrips, blossom weevils and tarnished plant bugs are likely to be a problem.

If possible avoid planting strawberries, into land which has been used long term for permanent pasture. Where as a result there is a high risk of the presence of soil borne insect pests i.e. the larvae of wireworm, leatherjackets and cockchafer. If planting of such sites cannot be avoided then soil samples should be taken, pre the destruction of the grass sward, to determine the level of infestation by wireworm larvae and hence the risk of damage to the strawberry crop. Where high levels of this pest are found, the use of a break crop or crops, prior to planting the strawberries. Or partial soil sterilisation may need to be used to render the site suitable for this soft fruit crop.

*Avoid soils with high populations of nematodes especially virus vectors *Xiphinema* and *Longidorus*.*

Rotations

Soil borne pests such as vine weevil and nematodes are less likely to become a problem with good use of crop rotation (see previous comments on rotations, Section 3.2). If you are not sure of the nematode status of your soil a test should be carried out.

Irrigation

Plants that are under stress from lack of water are more susceptible to certain pests such as two-spotted spider mite and tarsonemid mite. Avoid the plants coming under water stress.

Trash and runner removal

Removing trash and unwanted runners is in the main practised to aid the control of fungal diseases. However the levels of two-spotted spider mite may also be reduced if trash e.g. dead foliage, straw, etc

is removed from the field during the dormant period. Overwintering sites for slugs and tarnished plant bugs will also be reduced.

8.10.1.3 Integrated control

Integrated control of pests on Strawberries includes cultural, biological and chemical control, however its most important feature is regular crop monitoring. This should be carried out either by trained farm staff or a qualified advisor at least fortnightly during the growing season for aphids, two-spotted spider mites, caterpillars especially tortrix, seed beetles, tarsonemid mites, slugs, vine weevils, blossom weevils, capsids and other minor pests. 'Ever bearer' strawberry varieties should be monitored more frequently during their flowering period i.e. at least weekly and preferably twice per week for thrips, tarnished plant bugs and other flower pests.

Economic thresholds should be observed where applicable. The following tentative thresholds should be used only as a guide:

Thrips	one per flower
Tarnish plant bugs	one per ten plants
Strawberry aphid	one aphid per mature leaf or one per three young leaves. Nil tolerance if virus is likely to be present on the field or in adjacent fields
Shallot aphid	nil tolerance
Tarsonemid mite	nil tolerance
Vine weevil	nil tolerance

8.10.1.4 Biological control

Predatory and parasitic organisms are available to control a wide range of pest problems on horticultural crops. In many cases they are the most effective and most economic choice. With Strawberry culture at the present time there are several commercially proven biological control organisms available. *Phytoseiulus persimilis* controls two-spotted spider mite and *Bacillus thuringiensis* controls the caterpillars of tortrix moths, (see Appendix 3). These should be used as the first choice for both outdoor and protected cropping.

In the case of vine weevil, two different strategies can be adopted. Commercial preparations of predatory nematodes including the genus *Heterorhabditis* and *Steinernema* are available for controlling vine weevil larvae. These can be particularly successful in peat based composts. Alternatively, game bird species and chickens can be encouraged to forage in crops after harvest to feed on adult vine weevils.

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 an acceptable method of pest control under this protocol. However chemicals must be used as part of an integrated pest and disease management programme including cultural, biological and chemical control. Regular monitoring of Strawberry crops must be undertaken at least fortnightly through the growing season. A written record must be kept of all observations made and any subsequent recommendations.

With the exception of blossom weevil control, no insecticide should be applied prophylactically to Strawberry 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. In the case of blossom weevil, it is acceptable to use prophylactic treatments at specific times of the season when the pest is expected to appear.

Approved insecticides currently recommended for specific pests are:

Aphids	chlorpyrifos, dodecylphenol ethoxylate, natural plant extracts, nicotine, pirimicarb, pymetrozine (SOLA) rotenone, pyrethins
Capsids	nicotine, thiacloprid (SOLA), dodecylphenol ethoxylate
Caterpillars including tortrix	chlorpyrifos, <i>Bacillus thuringiensis</i> , nicotine, pyrethins
Spider mites	abamectin (SOLA) (for use on outdoor propagation and protected fruiting crops), clofentezine (SOLA), dodecylphenol ethoxylate, fenbutatin oxide (under protection only), bifenthrin, chlorpyrifos, natural plant extracts, tebufenpyrad, spiromesifen (SOLA) (under protection only), bifenazate
Slugs and snails	ferric phosphate, methiocarb, metaldehyde
Seed beetle	methiocarb (outdoor crops only)
Tarsonemid mite	abamectin (SOLA) (for use on outdoor propagation and protected fruiting crops), fenpyroximate (SOLA)
Vine weevil	chlorpyrifos
Chafer grubs, wireworms, leatherjackets	none recommended
Whitefly	dodecyl phenol ethoxylate, natural plant extracts, spiromesifen (SOLA) (under protection only)
Blossom weevil, pollen-beetle	chlorpyrifos (for blossom weevil)
Thrips	nicotine, spinosad (SOLA) (under protection only)
Leaf miner	abamectin (SOLA) (under protection only)

8.10.2 Disease control

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

For example, 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: e.g. good crop and field hygiene, maximising nutrient availability to promote crop health through soil analysis and accurate nutrient application to avoid excess.

Corrective action: If the above should 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 must be considered first.
- c. If chemical control is needed, the following points must 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 upon any 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

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.

Do not plant on soils known to have high levels of soil borne disease inoculum present including Verticillium wilt, (for which a soil test is available, see Appendix 7), red core or crown rot.

Avoid planting everbearer varieties close to 'June bearer' varieties (especially Elsanta). 'June bearers' tend to spread powdery mildew on to adjacent crops during late summer/early autumn.

If possible avoid planting any Strawberry variety close to old strawberry crops if they are infected with disease.

Avoid planting on frost prone sites or very exposed sites. Frost and/or wind damage provides entry points for fungal spores eg. Botrytis spores into frosted flowers.

Rotations

Specific soil borne diseases such as Verticillium wilt, Phytophthora fragariae and P. cactorum as well as various non-specific Rhizoctonia, Pythium and Phytophthora diseases, are less likely to build up to damaging levels if regular rotations are carried out. See previous comments on rotations in Section 3.2.

Irrigation

Plants that are under stress from lack of or excess of water are more susceptible to disease. Free water in the soil increases the spread of certain soil-borne diseases such as Phytophthora.

Trash and runner removal

Removal of trash and excess runners is a very effective hygiene measure to reduce the inoculum level of disease and to improve air flow through the canopy thus providing a micro climate more favourable for strawberry plant growth and less favourable for disease growth and spread.

Trash can be removed during the summer post harvest or in late winter/early spring. Do not attempt to remove trash during autumn/early winter as this can render the plants more sensitive to cold damage i.e. their natural insulation is removed.

8.10.2.3 Integrated control

At the present time integrated control opportunities are more limited for Strawberry diseases than for pests. However, there are several important guidelines that should be adhered to.

- a. There are no biological control methods for fungal diseases recommended in this protocol. However, the cultural controls outlined in Section 8.10.2.2 should be carefully observed.
- b. Currently, several diseases require prophylactic fungicide treatments in order to ensure control. However, there are other fungal diseases that only require fungicide or other treatments only after the disease has been observed in the plantation or known to be present in the soil. Note the listings below and do not apply prophylactic chemical treatments exclusively for control of pathogens listed under "non prophylactic" category.

Prophylactic	Non-prophylactic
<i>Botrytis</i> and other fruit rots Powdery mildew Red core (<i>Phytophthora fragariae</i>) routine sprays should only be applied if red core is known to be present in the soil.	Crown rot (<i>Phytophthora cactorum</i>) <i>Mycosphaerella</i> and <i>Zythia</i> <i>Colletotricum</i> <i>Rhizoctonia</i> Virus Green petal Phytoplasma <i>Verticillium</i> wilt

- c. Before applying fungicides growers must ensure that they use the product which is safest to the environment, natural predators and introduced biological control organisms as well as being efficacious for the particular disease concerned.

8.10.2.4 Chemical control (see also 8.10.8)

Consider the guidelines as laid down in Section 8.10.2.3, note that prophylactic treatments are only acceptable for powdery mildew, red core, *Botrytis* and other fruit rots.

Chemicals should only be used as part of an integrated pest and disease management programme. Regular monitoring of Strawberry crops must be undertaken at least fortnightly during the growing season. A written record must be kept of observations made and subsequent recommendations.

Prophylactic use of fungicides

Prophylactic use of fungicides is appropriate for control of powdery mildew, *Botrytis* and other fruit rots. However, it is **strongly recommended** that fungicide spray programmes use the minimum number of sprays necessary for good *Botrytis* and mildew control. Routine use of fungicides for control of red core is acceptable only where the problem is known to be present in the soil.

Powdery mildew	bupirimate, dinocap, fenarimol, fenpropimorph (SOLA), kresoxim-methyl, myclobutanil, potassium hydrogen carbonate, quinoxyfen (SOLA), sulphur
<i>Botrytis</i> and other fruit rots	boscalid + pyraclostrobin, captan, chlorothalonil, cyprodinil + fludioxonil, fenhexamid, iprodione, mepanipyrim, thiram, pyrimethanil.
Red core	fosetyl aluminium, dimethomorph (SOLA)

Non-prophylactic use of fungicides

The following fungicides must only be used to control these diseases if the disease has already been identified in the crop or a risk has been identified due to problems in preceding crops.

<i>Colletotrichum</i>	azoxystrobin (SOLA), boscalid + pyraclostrobin (SOLA), cyprodinil + fludioxonil. This is currently a notifiable disease, confirmed cases should be reported to Defra's Plant Health and Seeds Inspectorate
Crown rot	fosetyl aluminium, dimethomorph (SOLA)
Green petal	control leafhopper vector
<i>Mycosphaerella</i>	no fungicides are specifically recommended but chlorothalonil may give some control when used to control other diseases.
<i>Rhizoctonia</i>	usually only a problem under glasshouse conditions - iprodione.
<i>Verticillium</i> wilt	Soil sterilisation pre-planting, (but with the limitations as stated in Section 4.3) - chloropicrin, dazomet, metam sodium, formaldehyde, 1, 3 - dichloropropene. For further details on sterilants see Appendix 1.
Virus	control aphid or nematode vector.

Chemical application under protection

- It is **strongly recommended** that any additional operator and/or crop safety requirements should be

observed when applying agrochemicals under protection.

8.10.3 Weed control

Cultural control: *Cultivations between the crop rows is an acceptable method of weed control for in bare soil grown crops.*

*Polythene soil mulches may be used to suppress weeds and reduce the need for herbicides. However it is **strongly recommended** that all polythene materials be disposed of in a legal and environmentally responsible manner. Do not burn or bury polythene on the farm. Wherever possible polythene materials should be recycled.*

Hand weeding can be an economic proposition for removing perennial weeds and small weeds germinating in planting holes of polythene mulched crops.

Chemical control: Chemical control of weeds using residual and contact herbicides is acceptable. However attempts should be made to remove perennial weeds prior to planting. Translocated herbicides are the most suitable for this purpose. A list of herbicides currently approved is given Appendix 6. Do not allow herbicides to be unnecessarily leached into ground water. (See also 8.10.8).

8.10.4 Growth regulators

There are no current label recommendations or SOLAs for the use of growth regulators on Strawberries in the UK. As a result of current research, growth regulators may become a valuable tool in ICM.

8.10.5 Post harvest applications of pesticides

No pesticides are approved for application post harvest to Strawberry fruits.

8.10.6 Irradiation

Fruit should not be irradiated.

8.10.7 Post harvest destruction of Strawberry fields

If possible, do not allow weeds to go to seed, do not burn straw or other crop trash. If *Colletotrichum* has been confirmed on the site, the Plant Health and Seeds Inspectorate will give instructions on the disposal of the plants.

The normal procedure for destruction of the strawberry plants is, following an application of a translocated or contact herbicide, mow off the foliage after 7-10 days and follow with soil cultivation.

If vine weevils are present it is recommended that suitable control measures for this pest should be carried out at this stage (see Appendix 4).

8.10.8 Environmental pollution

Where chemical control is being employed, sprays must not be allowed to contact or drift onto field margins, ditches, lakes and watercourses. It is **strongly recommended** that applications of crop protection chemicals be made in such a way which will minimise the risk of environmental pollution. Be aware of any 'Buffer Zone' restrictions which appertain to individual pesticides. The restrictions relate to the proximity to a water course, the type of spray applicator being employed and the chemical product and rate being applied.

- As a general rule, the buffer zone restriction width for tractor mounted horizontal boom sprayers is 5

metres from the top of the bank of the watercourse.

- This applies to all pesticide products which are listed in Category A.
- For any product listed in Category B, a 'local environmental risk assessment for pesticides' (LERAP) must be carried out to ascertain whether the buffer zone can be reduced.
- A written record of any calculations carried out must be kept for future reference.
- For broadcast air - assisted applications, the widths are generally greater (eg. 18 metres or more) and can be even wider, due to the greater potential for spray drift problems with such applications. Buffer zones may now be reduced in certain circumstances where a LERAP for Broadcast air-assisted sprayers has been undertaken.
- Always refer to the DEFRA/PSD publications 'Local Environmental Risk Assessments for Pesticides - A Practical Guide' (Published 8th March 1999), 'Local Environmental Risk Assessment for Pesticides (LERAP) - Horizontal Boom Sprayers (published 2001)' and 'Local Environmental Risk Assessment for Pesticides (LERAP) - Broadcast Air-Assisted Sprayers (published 2002)'.

9 Harvesting and storage

9.1 Harvest

Smoking must not be allowed on the Strawberry field. All picking staff must be carefully supervised to ensure only quality fruit is picked and that high standards of personal hygiene are observed. All staff should receive training on their obligations regarding their fitness to work under the General Food Hygiene Regulations and appropriate toilet facilities must be provided.

It is **strongly recommended** that appropriate measures be always taken to avoid deterioration and damage of the product during and after harvest.

Picked fruit should be kept under shade at the collection point and removed from the field and placed in cold storage, to remove its field heat, within 45 minutes of picking.

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 Soil sterilants currently approved for use pre-planting of Strawberries

	Formaldehyde	Dazomet	Metam sodium
Rate of use	0.5 l/m ² diluted with 2.5l water	220-570 kg/ha	400-1000 l/ha
Physical form	Liquid	Granules	Liquid
Preferred soil temperature for effective treatment	Effective at 0° C	Above 10° C	Above 10° C
Application method	Soil drench. Terragator for field scale use	Best applied using specialist applicator	Injected into soil using specialist applicator
Requirement for polythene cover after treatment	No cover required	Polythene cover preferred, but surface can be sealed by smearing	Polythene cover preferred, but surface can be sealed by smearing
Preferred interval required prior to planting	At least 4 weeks, but a cress test is recommended	Usually 6 weeks, but a cress test is recommended	At least 7 weeks, but a cress test is recommended
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 and fungal diseases at higher doses
Human toxicity	Toxic if swallowed. Harmful in contact with skin or by inhalation	Harmful in contact with skin and if swallowed. Irritating to eyes skin and respiratory system	Irritating to eyes, skin and respiratory system

(1) The use in the UK of methyl bromide pre-planting of horticultural crops is under revocation. Its use pre-planting of strawberries is now severely restricted.

Appendix 1 Soil sterilants currently approved for use pre-planting of Strawberries (Cont'd)

	Chloropicrin	Steam	1,3-dichloropropene ⁽¹⁾
Rate of use	150 - 400 l/ha	15 kg/m ²	225-450 l/ha
Physical form	Liquid	Gas/liquid	Liquid
Preferred soil temperature for effective treatment	Above 10 ° C	Not applicable	Above 5 ° C
Application method	Injected into soil. Can only be applied by contractor	Injected into soil using special equipment	Injected into soil. Can only be applied by contractor
Requirement for polythene cover after treatment	Must be sealed with polythene sheets	Sheeted at time of treatment	Polythene cover preferred, but surface can be sealed after treatment by smearing
Preferred interval required prior to planting	At least 14-20 days (depending on product), but a cress test is recommended	No interval required	At least 6 weeks, but a cress test is recommended
Spectrum of activity	Good fungicide. High doses needed for good weed and nematode control	General biocide	Mainly nematicidal but some evidence that it controls <i>Verticillium</i> wilt
Human toxicity	Highly toxic. A chemical subject to the Poisons Act	Non toxic, but dangerous during application due to high temperatures	Toxic if swallowed. Harmful in contact with skin and by inhalation, Irritating to eyes, skin and respiratory system

⁽¹⁾ 3-Dichloropropene (2 January 2008)

Due to the EU review products containing 1,3-Dichloropropene will be suspended for advertisement; sale and supply with effect from 20 March 2008. Approval for use and storage will be suspended from 20 March 2009. In the UK there is only one product - Telone II (05749)

Appendix 2 Typical fertiliser requirements for Strawberries

Base dressings of macro-nutrients (kg/ha) should be made prior to planting according to the results of soil analysis indexes.

Nutrient (kg/ha)	Soil Index				
	0	1	2	3	3+
Nitrogen (N)	nil	nil	nil	nil	nil
Phosphate (P ₂ O ₅)	200	100	50	50	nil
Potash (K ₂ O)	200	100	50	nil	nil
Magnesium (MgO)	165	125	85	nil	nil

Well-rotted bulky organic manures can be applied and incorporated to improve soil structure of all soil types and 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
Cattle Farm manure (kg/t)	6.0	2.1	7.2	0.7
Undiluted slurry ⁽¹⁾ (kg/m ³)				
Cow (Dairy)	3.0	0.6	3.2	0.7
Pig	4.0	1.0	2.3	0.4
Poultry (Layer manure)	16.0	7.8	8.1	2.2

⁽¹⁾ adjust the values if diluted

⁽²⁾ for details of all fertiliser requirements and recommendations, see the MAFF publication 'Fertiliser Recommendations for Agricultural and Horticultural Crops (RB209)'. Note that this publication is currently under revision and that the new edition expected to be published in 2008 is likely to be amended. With regards to the range, nutrient content, timing of application and total amount of manures or composted green waste that can be applied pre-planting of cane fruit crops. No changes are expected however as to the recommendations, for fertiliser use pre-planting of strawberries.

Appendix 3 Biological control organisms (BCOs) used in Strawberry culture

Pest	Organism	Comments
Aphids	<i>Aphidius sp.</i>	Only suitable for use in protected crops. Open bottle placed in middle of house. Used at rates of 0.2 per m ² per week (preventive) or 0.5 per m ² per week (curative).
Aphids	<i>Aphidoletes aphidimyza</i>	Only suitable for use in protected crops. Used to give additional control to <i>Aphidius sp</i> at 1 perm ² from May - September.
Two-spotted spider mite	<i>Phytoseiulus persimilis</i>	Typical application rate is 25,000 predators per hectare but rate will depend upon level of infestation at time of introduction. Timing: a) outdoors: from mid May onwards when pest is seen. b) under protection: as soon as pest becomes active.
Two-spotted spider mite	<i>Feltiella acarisuga</i>	Can give additional control to <i>Phytoseiulus persimilis</i> . Boxes of this predatory midge can be introduced in glasshouses and fixed tunnels from April onwards.
Two-spotted spider mite	<i>Amblyseius californicus</i>	Use only permitted for AYR protected crops. Typical application rate of 4/m ² increased to 20/m ² where there are high levels of spider mite infestation
Tarsonemid mite	<i>Amblyseius cucumeris</i>	Typical application is 5 predators per plant, but rate will vary according to the severity of the infestation. Apply from the beginning of May to September.
Thrips	<i>Amblyseius cucumeris</i>	A predatory mite, it requires the leaves of plants to be touching to allow it to move between plants. For best results, introduce regularly and early when temperatures are 10 °C and above. Introduce at 50 perm ² per week if using shaker bottles.
Western flower thrips	<i>Steinernema feliae</i>	An insect parasitic nematode, application rate of 1 x 250 million try to 2000m ² of crop, increased to 1 x 250 million try to 1000m ² where levels of this pest are high
Slugs	<i>Phasmarhabdites hermaphrodita</i>	For slug control, 1 tray per 200L of water, applied at 2L/m ² . The temperature of treated soil or substrate must be between 5-30°C for at least 14 days after treatment
Tortrix caterpillar	<i>Bacillus thuringiensis</i>	0.5 - 1.0 kg/ha in minimum 1000 l/ha. No harvest interval. Apply when caterpillars are feeding. It is only necessary to control Tortrix post harvest if high levels are present.
Vine weevil	<i>Heterorhabditis megidis</i> <i>Steinernema carpocapsae</i> <i>Steinernema kraussei</i>	Soil and compost temperatures should not fall below 12 °C for 14 days following treatment. Soil and compost must be moist before application. The species <i>S. krausii</i> works down to 5 °C.
Sciarid flies	<i>Steinernema feltiae</i> <i>Hypoaspis miles</i> or <i>H. aculeifer</i>	Applied where this insect (larvae & adults) has become a problem of protected in substrate grown crops. The insect pathogenic nematode <i>Steinernema feltiae</i> is used at 0.5-1 million/m ² , requires a minimum growing media temperature of 10-14 C ⁰ . Can be very fast acting but lacks persistence. In contrast the predatory mites <i>Hypoaspis miles</i> or <i>H. aculeifer</i> are introduced onto compost at 100/ m ² (preventative) or 500/ m ² (curative). Establish well and persist, so can provide good background control of this pest.
Whitefly	<i>Encarsia formosa</i>	Only suitable for use in protected crops. Introduce at 1 black scale perm ² per week (preventive rate). Temperatures should be 18 °C for a few hours each day.

There are many other biological control organisms available and development work continues on their use for Strawberries. This presently includes work on slug, vine weevil, aphid, thrip and *Botrytis* control.

Appendix 4 Insecticides currently approved for Strawberries

Active Ingredient	Product Features	Approval Type	Harvest Interval ⁽¹⁾	LERAP Category	Hazard Rating	MRL (mg/kg)
abamectin	A selective acaricide and insecticide. Harmful to predatory mites and some other predators. SOLA's for use only on protected fruiting and outdoor propagation crops. 3 applications permitted/year	SOLA's 0423/07 expires 31/12/13 & 0418/07 expires 31/07/08	3 days	none stated	Harmful Irritant	EC Definitive 0.100
<i>Bacillus thuringiensis</i>	A bacterial insecticide for control of caterpillars. Safe for use in I.P.M. programmes. Approved on outdoor and protected crops.	Full until 31/12/13	none stated	none stated	none stated	none set
bifenazate	A carbazate has a unique effect upon GABA receptors in the neuro transmitter system. Activity against two spotted spider mite and tarsamerrial mite. Contact action use only on protected strawberry crop. Two applications/year	Full until 30/11/15	7 days	none stated	none stated	EC Definitive 1.0
bifenthrin	Synthetic pyrethroid acaricide: Effective control of two-spotted spider mite adults and larvae. Very harmful to predators. Use only as a last resort. Approved on outdoor and protected crops. 2 applications permitted/year	Full according to product approval expires 31/12/13	none stated	A	Harmful Irritant	EC Definitive 1.0 (Codex)
chlorpyrifos	Organophosphate insecticide: contact and ingested activity. Approved on outdoor and protected crops, but can cause crop damage under protection in certain situations. Rate of use and number of applications/year according to product	Full according to product approval expires 31/05/08, 31/08/08, 30/06/11, 31/12/13	7 days	A	Harmful Irritant	EC Definitive 0.200 0.3 (Codex)
clofentezine ⁽²⁾	Ovicidal tetrazine acaricide: effective control of eggs and young larval stages of two-spotted spider mite. Safe to predators useful part of integrated control programme. SOLAs on outdoor and protected crops. Up to 3 applications permitted/year.	SOLA's 2269/01 expires 31/12/13 & 2271/01 expires 31/12/13	14 days - outdoor 7 days - protected	none stated	none stated	EC Definitive & Codex 2.0
dodecylphenol ethoxylate	Physical mode of action, working by suffocating the insects. Compatible with IPM programmes. Safe to bees. Controls aphids and whitefly and offers some suppression of two-spotted spider mite, mealy bug and leafhopper. Approved on outdoor and protected crops.	Full	nil	none stated	none stated	none stated

Notes:

* level at or about the limit of determination (L.O.D.)

(1) or latest time of application

(2) SOLA - see appendix 7 for specific products and expiry dates

MRL's are for strawberries (other than wild)

Not all formulations of these active ingredients may be currently approved for use on Strawberries. Check before use. Label recommendations are revised regularly, read a current label before use.

Appendix 4 Insecticides currently approved for Strawberries (Cont'd)

Active Ingredient	Product Features	Approval Type	Harvest Interval ⁽¹⁾	LERAP Category	Hazard Rating	MRL (mg/kg)
fenpyroximate	A mitochondrial electron transport inhibitor (METI) acaricide, kills motile stages of two spotted and tarsonemid mite. 1 application permitted/annum	SOLA 0902/07 until 31/12/13	3 days	None stated	Toxic Harmful	E C Provisional 0.500
fenbutatin oxide	An organotin acaricide: selective contact and ingested organotin acaricide. Very safe to predators. Only approved for use under protection. 2 applications/year	Full. Product is on revocation. Final use and on-farm storage date 31/08/08	7 days	none stated	Toxic Irritant	E C Definitive 1.0
ferric phosphate	Non hazardous molluscicide which breaks down into iron and phosphate in the soil, becoming available for plant nutrition. Maximum dose per ha /year of 200kg. Use on outdoor & protected crops	Full until 31/10/11	none stated	none stated	none stated	none set
metaldehyde	Molluscicide – approved on outdoor and protected crops.	Full. Expiry date varies according to product from 30/09/08 to 31/12/13	none stated	none stated	none stated	none set
methiocarb	Carbamate, molluscicide insecticide: stomach acting. Will kills ground beetles that are predate on vine weevil. Use metaldehyde in preference if slug problem not severe and a seed beetle problem is not anticipated. Approved for use on outdoor crops only. 1 application permitted/year. Outdoor crop only.	Full. Expiry date varies with product from 29/02/08 until 31/12/13	7 days	none stated	Harmful	none set
natural plant extracts	Physical mode of action with activity against a range of pests including two-spotted spider mites, aphids, thrips and whitefly. Approved on outdoor and protected crops.	Pesticide with physical properties falling outside the scope of 'Control of pesticide regulations'	nil	none stated	none stated	none stated
nicotine	Non-persistent alkaloid insecticide with contact action. Broad spectrum. Kills beneficial insects and predators. Approved on outdoor and protected crops. Only some products with use on strawberry	Full. Expires 31/12/13	2 days	none stated	Toxic Harmful	none set
pirimicarb	Carbamate insecticide; aphid specific. Very safe to natural predators and introduced BCO's. An important chemical for integrated control programmes. Contact translaminar and powerful fumigant activity. Approved on outdoor and protected crops.	Full. Expires 31/12/13	3 days	none stated	Harmful	Codex 0.500

Notes:

(1) or latest time of application

MRL's are for strawberries (other than wild)

Not all formulations of these active ingredients may be currently approved for use on Strawberries. Check before use. Label recommendations are revised regularly, read a current label before use.

Appendix 4 Insecticides currently approved for Strawberries (Cont'd)

Active Ingredient	Product Features	Approval Type	Harvest Interval ⁽¹⁾	LERAP Category	Hazard Rating	MRL (mg/kg)
pymetrozine ⁽²⁾	Azomethine insecticide. Safe to predatory insects. Separate SOLAs for use in outdoor and protected crops. 3	SOLA's 1702/06 & 0461/06 until 31/10/11 (for outdoor crop) SOLAs 0499/07 & 0504/07 until 31/10/11 & 0492/07 & 0496/07 until 31/07/08 (for protected crop)	SOLAs 0499/07, 0496/07 & 0461/06 3 days SOLAs 1702/06, 0492/07 & 0504/07 12 weeks	none stated	none stated	E C Definitive 0.500 0.05 * (UK)
rotenone	A natural contact insecticide of low persistence. Contact action broad-spectrum, short persistence useful where natural predators are being used for two spotted spider mite control.	Full until 31/12/13, approved for use on outdoor & protected strawberry crop	1 day	none stated	none stated	none set
pyrethrins	Non persistent contact insecticide extracted from pyrethrum. IRAC mode of action code 3. Activity against aphids, caterpillars, spider mites & white fly. Use on outdoor & protected crops	Full until 31/12/13	1 day	none stated	Dangerous to environment	None set
spinosad	A selective insecticide with low impact to many insect and mite predators but harmful to adults of most parasitic wasps. Exposure to direct spray is harmful to bees. SOLA for use in protected crops only. 3 applications permitted/year	SOLA 1173/05, expires 30/04/13	1 day	B	Danger to environ.	U K Temporary 0.300
spiromesifen	A cyclic ketoenole insecticide. SOLA only for use on protected crop grown in inert substrates or NFT. 2 applications permitted/year	SOLA 0957/05 expires 30/04/13	3 days	none stated	Toxic Harmful	UK Temporary 1.00
tebufenpyrad (MAPP 13082)	A pyrazole mitochondrial electron transport inhibitor aphicide and acaricide. Approved on outdoor and protected crops. 1 application permitted/year	Full. UNTIL 31/12/13	3 days	B	none stated	none set
thiacloprid ⁽²⁾	A chloronicotinyl insecticide. Safe to most predatory insects. Separate SOLAs for use in outdoor and protected crops.	SOLA 0334/06 (for protected crop) & 0333/06 (for outdoor crop) expires 31/12/14	3 days	none stated	Harmful	E C Provisional .500

Notes:

* level at or about the limit of determination (L.O.D.) Temporary UK MRL

⁽¹⁾ or latest time of application

⁽²⁾ SOLA - see appendix 7 for specific products and expiry dates

MRL's are for strawberries (other than wild)

Not all formulations of these active ingredients may be currently approved for use on Strawberries. Check before use. Label recommendations are revised regularly, read a current label before use.

Appendix 5 Fungicides currently approved for Strawberries

Active Ingredient	Product Features	Approval Type	Harvest Interval ⁽¹⁾	LERAP Category	Hazard Rating	MRL (mg/kg)
azoxystrobin ⁽²⁾	Systemic translaminar protectant strobilurin fungicide. Approved for use in outdoor and protected crops. 4 applications permitted/year	SOLA 1294/02 expires 31/12/11	3 days	none stated	none stated	E C Definitive 2.00
boscalid + pyraclostrobin	Protectant systemic strobilurin fungicide. Full approval on outdoor & protected crops. SOLA on protected crops. 2 applications/year permitted.	Full and SOLA 1673/04 expires 30/09/13	3 days	B	Irritant	UK Temporary 3.00 for boscalid UK Temporary & EC Provisional 0.50 – for pyraclostrobin
bupirimate	Systemic pyrimidinol: protectant and eradicant. Approved for use in outdoor and protected crops.	Full. Expires 31/08/08 or 31/12/13 according to product	1 day	none stated	Irritant	none set
captan	Protectant dicarboximide. Approved for use in outdoor and protected crops. No limitations on use. Not to be used on crops for processing 'canning'	Full. Expires 30/09/10	7 days	none stated	Harmful Irritant	E C Definitive 3.00
chlorothalonil	Protectant chlorophenyl: protectant and eradicant Approved for use on outdoor crops only.	Full. Expires 28/02/11 or 31/12/13 according to product SOLAs 0987/07 until 28/02/11 1253/02 & 1635/01 until 31/12/13	Full - 14 days SOLAs -3 days	B	Irritant	E C Definitive 3.00
Cyprodinil + fludioxonil	A mixture containing, a broad spectrum systemic anilinopyrimidine and cyanopyrrole fungicide. For use on , outdoor & protected crops. 2 applications permitted/year	Full	3 days	B	Harmful Irritant	UK Temporary 5.00 for cyprodinil Import Tolerance 2.00 for fludioxonil
dimethomorph	A cinnamic acid fungicide with translaminar activity. 2 applications permitted/year. For use during propagation and on outdoor fruiting crops as an over all spray. For protected crop application must be via trickle irrigation system	SOLA 1751/06 until 31/05/08	35 days	B	Harmful	None set

Notes:

* level at or about the limit of determination (L.O.D.)

(1) or latest time of application.

(2) SOLA - see appendix 7 for specific products and expiry dates

MRL's are for strawberries (other than wild)

Not all formulations of these active ingredients may be currently approved for use on Strawberries. Check before use. Label recommendations are revised regularly, read a current label before use.

Appendix 5 Fungicides currently approved for Strawberries (Cont'd)

Active Ingredient	Product Features	Approval Type	Harvest Interval ⁽¹⁾	LERAP Category	Hazard Rating	MRL (mg/kg)
dinocap	Protectant dinitrophenyl. Approved for use in outdoor and protected crops. Due to 3 year inclusion in Annex 1 approval is expected to be revoked with final use on or before 31/12/10	Full until 30/06/08	7 days	B	Harmful irritant	none set
fenarimol	Systemic curative and protective pyrimidine: eradicant activity. Approved for use in outdoor and protected crops.	Full until 30/06/09	14 days	none stated	none stated	E C Definitive 0.30
fenhexamid	Protectant sulfamide: very effective against <i>Botrytis</i> . Approved for use in outdoor and protected crops.	Full until 31/05/11	1 day	none stated	none stated	E C Provisional 5.00
fenpropimorph ⁽²⁾	Contact and systemic morpholine fungicide. Approved for use on outdoor crops only.	SOLAs 0629/04, 0802/04, 0804/04 expire 31/12/13	14 days	none stated	Harmful Irritant	E C Definitive 1.00
fosetyl aluminium ⁽²⁾	Systemic phosphonic acid. Full and SOLA approved for use in outdoor and protected crops. 2 applications permitted/year	Full according to product until 31/08/08 or 31/12/13 SOLAs 1900/07 expires 31/08/08 & 3517/06 expires 31/12/13	3 months 14 days	none stated	none stated	none set
iprodione	Protectant eradicant dicarboximide. Approved for use in outdoor and in some cases also protected crops depending upon product . 4 applications permitted/year rate according to product. Rovral WG (MAPP 13811) For use on outdoor and protected crops. 4 applications/yr. Rate of individual application 1kg/ha	Full according to product until 31/08/08 or 31/12/08 Except Rovral WG (MAPP 13811) Full approval until 31/12/13	1 day or for Rovral WG (MAPP 13811) 2 days	none stated B for Rovral WG MAPP 13811)	Irritant Harmful	E C Provisional 10.00
kresoxim-methyl	Protectant strobilurin fungicide. Approved for use in outdoor and protected crops 3 applications permitted/year	Full until 31/12/11	14 days	B	none stated	E C Definitive 1.00
mepanipyrim	Anilinopyrimidine fungicide with protectant activity. Approved for use in outdoor and protected crops. 2 applications permitted/year	Full until 30/09/14	3 days	B	none stated	E C Provisional 2.00
myclobutanil	Systemic, protectant and curative conazole fungicide. Approved for use in outdoor and protected crops. Maximum total dose of 2.7L/ha/year	Full until 31/12/13	3 days	none stated	none stated	E C Definitive 1.00

Notes:

* level at or about the limit of determination (L.O.D.)

(1) or latest time of application

(2) SOLA - see appendix 7 for specific products and expiry dates

MRL's are for strawberries (other than wild) Not all formulations of these active ingredients may be currently approved for use on Strawberries. Check before use. Label recommendations are revised regularly, read a current label before use.

Appendix 5 Fungicides currently approved for Strawberries (Cont'd)

Active Ingredient	Product Features	Approval Type	Harvest Interval ⁽¹⁾	LERAP Category	Hazard Rating	MRL (mg/kg)
pyrimethanil	Anilinopyrimidine fungicide. Approved for use in outdoor and protected crops. 2 applications permitted/year	Full until 31/12/13	1 day	B	none stated	none set
potassium hydrogen carbonate	Naturally occurring compound that offers protection and control against powdery mildew. Compatible with IPM programmes and offers no residue problems. For use in outdoor and protected crops. Maximum individual dose of 20g/L, maximum total dose 60kg/ha/year	Commodity substance	none stipulated	none stated	none stated	none set
quinoxifen	A systemic protectant fungicide for protection against powdery mildew. It has no curative properties. SOLA for use in outdoor and protected crops.	SOLA 1923/04, expires 1/09/14	14 days	B	Irritant	E C Provisional 0.300
sulphur	Inorganic protectant fungicide and foliar feed. Approved for use in outdoor and protected crops. Some products state a maximum of 4 applications/crop	Full until 31/12/13	none stated	none stated	none stated	none set
thiram	Protectant dithiocarbamate. Approved for use in outdoor and protected crops.	Full according to product until 31/12/08 or 31/07/09	7 days	none stated	Harmful Irritant	E C Definitive from 19/03/08 10.00

Notes:

* level at or about the limit of determination (L.O.D.)

(1) or latest time of application

(2) SOLA - see appendix 7 for specific products and expiry dates

MRL's are for strawberries (other than wild)

Not all formulations of these active ingredients may be currently approved for use on Strawberries. Check before use. Label recommendations are revised regularly, read a current label before use.

Appendix 6 Herbicides currently approved for use on Strawberries

Pre planting herbicides

Active Ingredient	Product Features	Approval Type	Harvest Interval ⁽¹⁾	LERAP Category	Hazard Rating	MRL (mg/kg)
asulam ⁽²⁾	Pre planting when docks growing well. Allow 6 weeks between application and harvest. 1 application/year	SOLAs 2182/07 & 2188/07 until 30/09/08 & 0824/07 until 31/12/13	pre-planting and post harvest or before 31 March in year of harvest	none stated	none stated	none set
carfentrazone-ethyl	A triazolinone contact herbicide. 1 application permitted pre-planting of crop	Full until 24/08/09	1 month before planting	none stated	Harmful	E C Provisional 0.010*
glyphosate	Perennials and annuals post emergence. Allow a minimum 10 days before cultivating.	Full until 20/06/12 (date varies according to product)	pre-planting	B	Harmful Irritant	E C Provisional 0.100*
trifluralin	Apply at any time up to 14 days before planting but at least one day should elapse between incorporation and planting.	Full ⁽³⁾ Approval revoked last date of use 20/03/09	pre-planting	none stated	Harmful Irritant	none set

Notes:

* level at or about the limit of determination (L.O.D.)

(1) or latest time of application

(2) SOLA - see appendix 7 for specific products and expiry dates

(3) A review of trifluralin usage has recently been carried out & its continued usage pre-planting of cane fruit crops was not supported. Products are on revocation but may continue to be used until expiry date of 20/03/09

MRL's are for strawberries (other than wild)

Not all formulations of these active ingredients may be currently approved for use on Strawberries. Check before use. Label recommendations are revised regularly, read a current label before use.

Appendix 6 Herbicides currently approved for use on Strawberries (Cont'd)

Post planting herbicides

Active Ingredient	Product Features	Approval Type	Harvest Interval ⁽¹⁾	LERAP Category	Hazard Rating	MRL (mg/kg)
asulam ⁽²⁾	Pre planting when docks growing well. Allow 6 weeks between application and harvest. 1 application permitted/year	SOLAs 2182/07 & 2188/07 until 30/09/08 & 0824/07 until 31/12/13	pre-planting and post harvest or before 31 March in year of harvest	none stated	none stated	none set
chlorthal dimethyl	Do not use on organic soils. Do not use during flowering/fruitletting. 1 application permitted/year	Full until 31/12/13	pre-flowering post-harvest	none stated	none stated	none set
clopyralid	Foliar translocated herbicide. Do not use during flowering or fruitletting. Do not use during flower initiation. Maximum total dose of 1.5L/ha/year permitted	Full until 31/12/13	28 days	none stated	none stated	none set
cycloxydim	Translocated post emergence oxime herbicide for grass weed control. 1 application/year permitted	Full until 31/12/13	6 weeks	none stated	Irritant	none set
diquat	A non--residual bipyridyl contact herbicide and crop desiccant. Activity only against broad-leaved weeds. Some products state maximum individual rate and total dose/ha/yr as 2L/ha. Other products rate 1.5-2L/ha with no restriction on number of applications/yr	Full date of expiry 31/12/11 or 31/12/13	none stated	none stated	Harmful Toxic	E C Provisional 0.050*
fluzifop-p-butyl	Do not use during flowering/fruitletting. Plantation must be at least 6 months old. 1 application/year permitted	Full until 31/12/13	pre-flowering post-harvest	none stated	Irritant	none set

Notes:

* level at or about the limit of determination (L.O.D.)

(1) or latest time of application

(2) SOLA - see appendix 7 for specific products and expiry dates.

MRL's are for strawberries (other than wild)

Not all formulations of these active ingredients may be currently approved for use on Strawberries. Check before use. Label recommendations are revised regularly, read a current label before use.

Appendix 6 Herbicides currently approved for use on Strawberries (Cont'd)

Post planting herbicides (Cont'd)

Active Ingredient	Product Features	Approval Type	Harvest Interval (1)	LERAP Category	Hazard Rating	MRL (mg/kg)
glufosinate - ammonium	A contact, post emergence herbicide. Apply up to 3 treatments between 1 March and 30 September.	Full until 31/12/13 (varies according to product)	1 March - 30 Sept	none stated	Harmful Irritant	none set
isoxaben	Use between 1 November and 31 March. 1 application/year permitted	Full until 31/12/13	1 Nov- 31 Mar	none stated	none stated	none set
lenacil	Can be applied to maiden and established plantations. Do not apply to sands or heavy soils or from flowering to fruiting. 1 application/year permitted	Full until 31/12/13	pre-flowering post-harvest	none stated	none stated	none set
napropamide	Use between November and February as a soil acting herbicide. 1 application/year permitted	Full until 31/12/13	Nov - Feb	none stated	none stated	none set
paraquat	Paraquat is subject to the Poisons Act 1972. Only spray between the rows, not directly on to the crop. Do not apply during flowering-fruiting period	Full until 11/07/08	none stated	none stated	Toxic Harmful Irritant	E C Definitive 0.020*
paraquat + diquat	Paraquat is subject to the Poisons Act 1972. Only spray between the rows, not directly on to the crop. Do not apply during flowering-fruiting period	Full until 11/07/08	none stated	none stated	Toxic Harmful Irritant	E C Definitive 0.020* for paraquat E C Provisional 0.050* for diquat
pendimethalin	Do not apply immediately post harvest to mid September: (ie during flower initiation), nor after the beginning of crop growth in the spring. 1 application/year permitted. Rate 3.3 – 5L/ha for products with approvals until 31/08/08. Up to 3.3L/ha for products with approval expiry dates 18/11/09 & 31/12/13.	Full until 31/08/08, 18/11/11 or 31/12/13 N.B. (date varies according to product)	mid-Sept to spring re-growth	B	none stated	E C Definitive from 15/06/08 0.050*

Notes:

* level at or about the limit of determination (L.O.D.)

(1) or latest time of application

MRL's are for strawberries (other than wild)

Not all formulations of these active ingredients may be currently approved for use on Strawberries. Check before use. Label recommendations are revised regularly, read a current label before use.

Appendix 6 Herbicides currently approved for use on Strawberries (Cont'd)**Post planting herbicides (Cont'd)**

Active Ingredient	Product Features	Approval Type	Harvest Interval (1)	LERAP Category	Hazard Rating	MRL (mg/kg)
phenmedipham	Do not use on Strawberries under protection. Do not use during flowering/fruiting. 2 applications/year permitted	Full. Last date of use 31/08/08	pre-flowering post-harvest	none stated	Harmful irritant	E C Provisional from 21/01/08 0.050*
propachlor ⁽²⁾	Do not use during flowering/fruiting. Propachlor must not be applied to new plantings, freshly dug runners, runners which have damaged leaves or runners which have been rolled. For use only on outdoor crops only.	Full according to product until 31/01/09 or 31/12/13 SOLA 2540/07 until 31/01/09 1159/02 until 31/12/13	none stated	none stated	Harmful irritant	none set
propyzamide	Do not use on soils of more than 10% OM. Do not use on sandy or very light soils. Only apply between October and December to plants that have been established for at least 12 months. 1 application permitted per 9 months	Full until 31/12/13 for some products, others expire 31/08/08 or 31/03/09	Oct - Dec	none stated	none stated	E C Provisional 0.020*

Notes:

* level at or about the limit of determination (L.O.D.)

(1) or latest time of application

(2) SOLA - see appendix 7 for specific products and expiry dates.

MRL's are for strawberries (other than wild)

Not all formulations of these active ingredients may be currently approved for use on Strawberries. Check before use. Label recommendations are revised regularly, read a current label before use.

Appendix 7 Specific off-label approvals for use on Strawberries

Number	Product Name	Ingredient	Expiry
1900/07	Aliette 80 WG (11213) ®	Fosetyl-aluminium	31/08/08
3517/06	Aliette 80 WG (13130) ®	Fosetyl-aluminium	31/12/13
2540/07	Alpha propachlor 50 SC (04873) ®	Propachlor	31/01/09
1294/02	Amistar (10443) ®	Azoxystrobin	31/12/11
2269/01	Apollo 50 SC (10590) ®	Clofentezine	31/12/13
2271/01	Apollo 50 SC (10590) ®	Clofentezine	31/12/13
0824/07	Asulox (13175) ®	Asulam	31/12/13
2182/07	Asulox (09969) ®	Asulam	30/09/08
2182/07	Asulox (09969) ®	Asulam	30/09/08
1635/01	Bravo 500 (10518) ®	Chlorothalonil	31/12/13
0333/06	Calypso (11257) ®	Thiacloprid	31/12/14
0334/06	Calypso (11257) ®	Thiacloprid	31/12/14
0492/07	Chess WG (10651) ®	Pymetrozine	31/07/08
0496/07	Chess WG (10651) ®	Pymetrozine	31/07/08
0499/07	Chess WG (13310) ®	Pymetrozine	31/10/11
0504/07	Chess WG (13310) ®	Pymetrozine	31/10/11
0802/04	Cleancrop Fenpro (09885) ®	Fenpropimorph	31/12/13
0629/04	Cleancrop Fenpropimorph (09445) ®	Fenpropimorph	31/12/13
0987/07	Cleancrop Rio (13332) ®	Chlorothalonil	28/02/11
1253/02	Clortosip 500 (09320) ®	Chlorothalonil	31/12/13
0804/04	Corbel (00578) ®	Fenpropimorph	31/12/13
0423/07	Dynamec (13331) ®	Abamectin	31/12/13
0418/07	Dynamec (12539) ®	Abamectin	31/07/08
1923/04	Fortress (08279) ®	Quinoxifen	01/09/14
0957/05	Oberon (11819) ®	Spiromesifen	30/04/13
1751/06	Paraat ®	Dimethomorph	31/05/08
1702/06	Plenum WG (10652) ®	Pymetrozine	31/10/11
0461/06	Plenum WG (10652) ®	Pymetrozine	31/10/11
1159/02	Ramrod Flowable (10314) ®	Propachlor	31/12/13
0902/07	Sequel (12657) ®	Fenpyroximate	31/12/13
1673/04	Signum (11450) ®	Boscalid/pyraclostrobin	30/09/13
1173/05	Tracer (12438) ®	Spinosad	30/04/13

Notes:

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

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

Appendix 8 Verticillium wilt testing

A test for *Verticillium* wilt resting bodies is available. The test reveals the number of microsclerotia in the soil and gives a good indication of the likelihood of *Verticillium* wilt; problems occurring for major Strawberry varieties, which are ranked according to susceptibility. The test should be carried out whenever contemplating planting in soils where potatoes or linseed have been grown or where *Verticillium* wilt has caused losses in a previous Strawberry crop or where there is doubt as to the *Verticillium* wilt status of the soil

Appendix 9 Guidelines for minimising pesticide residues in strawberries

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 potential alternative strategies.

Active ingredient	Target: pest, weed, disease	Current position	Suggested guidelines
azoxystrobin	black spot	residues found regularly	Increased use of cultural control - see guidelines below.
bupirimate, myclobutanil, fenpropimorph	powdery mildew	residues found regularly	Increased use of cultural control - see guidelines below.
iprodione, fenhexamid, tolylfluanid, pyrimethanil	<i>Botrytis</i>	residues found regularly	Increased use of cultural control - see guidelines below.
mepanipyridin, chlorothalonil	<i>Botrytis</i>	residues found occasionally	Increased use of cultural control - see guidelines below
kresoxim-methyl	powdery mildew	residues found occasionally	Increased use of cultural control - see guidelines below
pirimicarb	aphids	residues found regularly	Gain early control - see guidelines below.
chlorpyrifos	aphids, caterpillars, weevils	residues found occasionally	Increase harvest interval to 28 days - see guidelines below.

Guidelines:

Consumers and retail customers are raising increasing concerns over the incidence of pesticide residues occurring in fresh produce. Their desire to purchase produce that is free from residues has necessitated strawberry growers to consider ways and means of minimising the risk of any residues from occurring in their harvested product.

Assured Produce, in consultation with technical representatives from all of the major marketing groups and producer organisations have considered the problems facing the strawberry industry and in particular those active ingredients that are found during the production season in the UK.

Having identified a list of these active ingredients, they have formulated guidance notes on potential crop protection and crop management strategies that growers may wish to follow to minimise the risk of residues occurring.

Active Ingredients Found in UK Strawberries

Following good agricultural practice and integrated crop management should avoid any MRL exceedances in the first place. The table below lists those active ingredients found in strawberries. It is not a list of MRL exceedances but where residues are reported between the MRL and the limit of detection. Each has a star rating, depending upon the frequency in which they are found:

*** Residues found regularly in samples

** Residues found less regularly in samples

* Residues found occasionally in samples

Appendix 9 Guidelines for minimising pesticide residues in strawberries (Cont'd)

Crop	Chemical type	Active Ingredient	Typical Product Name	H.I.Days	Star Rating
Strawberry	Fungicide	azoxystrobin	Amistar	3	***
		bupirimate	Nimrod	1	***
		myclobutanil	Systhane 20EW	3	***
		iprodione	Rovral WP	1 or 2	***
		fenpropimorph	Corbel, Cleancrop Fenpro etc	14	***
		chlorothalonil	Bravo 500, Cleancrop Rover etc	14&3	***
		pyrimethanil	Scala	1	***
		fenhexamid	Teldor	1	***
		chlorothalonil	Bravo 500, Cleancrop Rover etc	14 & 3	*
		mepanipyrim	Frupica SC	3	*
		kresoxim-methyl	Stroby WG	14	*
		Insecticides	chlorpyrifos	Lorsban WG etc	7
	pirimicarb		Aphox	3	**

Possible Solutions to Minimise these Residues

A number of suggestions have been formulated to minimise the risk of some of these active ingredients occurring in residue analyses for both insecticides and fungicides. Suggestions have only been offered where a strategy is considered to be reasonable and can be practically achieved.

Insecticides

Chlorpyrifos (Lorsban WG)

Our guidance is that Chlorpyrifos should not be applied closer than 28 days before harvest to strawberry crops unless the following scenarios develop:

- When planning to apply pirimicarb (Aphox), nicotine, pymetrozine or rotenone (Derris), prevailing temperatures are such that these chemicals will fail to work effectively.
- The permitted number of thiacloprid applications (two) has already been made to the strawberry crop.
- The use of bifenthrin (Talstar) will prevent the proposed introduction of predatory insects into the crop for some 8 weeks or more due to the persistence of this chemical.

Fungicides

Many fungicides are applied on a prophylactic basis in strawberries to control aerial fungal diseases such as *Botrytis*, powdery mildew and black spot. They are therefore applied routinely up until harvest.

It is generally accepted that any fungicide that is applied within 21 days of harvest is at risk of appearing in a residue analysis.

The only certain way of preventing pesticide residues from occurring in harvested strawberries is to avoid the application and use of the listed fungicides altogether. However, this is not feasible at present given the high disease pressure placed upon strawberry crops during the production season.

Therefore, the most practical way to minimise the risk of residues occurring is to reduce the need to rely so heavily upon prophylactic fungicide treatments. This is best achieved by following specific crop management techniques to reduce the risk of infection and spread of diseases.

Powdery Mildew

The move towards protected cropping beneath portable polythene tunnels has in some cases favoured the rate of infection and spread of this disease due to increased levels of humidity and air movement across the leaf surface (particularly on crops supported on tables or similar structures). The suggested management practices are summarised as follows:

- When purchasing plants from propagators, ensure that they are free from powdery mildew infection.
- When establishing a new plantation, consider site selection very carefully. Avoid choosing sites which are down wind of existing strawberry plantations, which are likely to be infected or contain varieties which are highly susceptible to the disease.
- Rely upon the use of prophylactic treatment with fungicides soon after planting, making use of fungicides with both eradicant and protective properties to avoid early infection occurring. This should maintain disease free plants and reduce the need to apply fungicides closer to harvest.
- Where crops are to be retained over the winter period for cropping the following spring/summer, assess crops in the autumn for the presence of resting spores (cleistothecia) which can give rise to early infection in the following spring. Where present, be prepared to use a fungicide with eradicant properties to gain early control in the spring.
- Make sure that all cropping sites are well sheltered to reduce the movement of air currents across the leaf canopy. Experience has shown that this appears to favour infection and spread in some crops (particularly those on tables or other supports). In some cases, it may be worth erecting temporary barriers to the wind to avoid such air currents.
- Those crops being grown under tunnels or other forms of protection should always be adequately vented to avoid the build up of humidity which favours powdery mildew infection. Growers should always have some means of measuring humidity under protection and a system which allows them to vent swiftly should humidity rise too high. The importance of proactive tunnel environment management cannot be stressed too highly.
- When feeding plantations, avoid excess use of nitrogen which can lead to the production of soft growth which is more susceptible to infection. The use of regular leaf analyses is helpful to monitor the uptake and existing levels of nitrogen in the leaf.
- To minimise the risk of pesticide residues in fruit at harvest, where feasible close to and during harvest, adopt especially for varieties of every bearer strawberries susceptible to this disease, a programme of alternating applications of sulphur and potassium hydrogen carbonate.

Botrytis

In recent seasons, the incidence of *Botrytis* has decreased slightly due to the fact that increasing numbers of field grown crops are now protected by temporary tunnel structures. This helps to maintain a drier environment around the plants and reduces rain and water splash from soil or debris onto developing flowers and fruits. The fact that recent summer weather has been drier than the long term average has also helped. However, some crops are still left unprotected (particularly late main season varieties and 60-day type Elsanta plants) and these are at greater risk. For those crops which are protected by tunnel structures, the outside beds of leg rows of the tunnels are more at risk as a result of rain splash from the soil onto the crop row.

Cultural suggestions to reduce the incidence of *Botrytis* are summarised below:

- When purchasing plants from propagators, ensure that they are free from *Botrytis* infection.
- Where possible, make use of portable tunnels to protect crops from wet weather conditions, thus reducing the risk of infection and spread.
- Where crops are being grown under tunnel structures, ensure that outside rows or beds of plants are set back by 1 metre from the tunnel leg (giving a total of 2 metres between the outside beds of each tunnel) to reduce the effect of

soil/rain splash. Be sure to use mulches such as straw or Mypex permeable membrane along the length of the leg rows to further reduce this risk.

- Consider the use of gutters or other forms of water removal from the polythene, which covers the tunnel, to avoid the action of rain splash altogether. Care to manage the run off at the headland is required.
- Those crops being grown under tunnels or other forms of protection should always be adequately vented to avoid the build up of relative humidity, which favours *Botrytis* infection. Growers should always have some means of measuring the humidity where crops are being grown under protection and a system which allows them to vent the glasshouses or tunnels swiftly should the humidity rise too high.
- Where crops are to be retained for cropping in second and subsequent seasons, all over wintered trash (straw) and crop debris should be removed from the plantation, in the late winter or early spring before the onset of new growth. This will reduce the quantity of *Botrytis* resting spores carried over into the new season.

Black spot

Black spot is similar to *Botrytis* in that infection and spread is favoured by warm, wet and humid conditions. Rain splash is particularly associated with this disease, during hot and humid periods of the year (most notably in August in the UK). The now widespread use of tunnels to provide protection to the strawberry crop has helped to reduce the incidence of the disease during the recent seasons, also especially in dry years. However, like *Botrytis*, crop rows or beds on the outside leg rows of tunnels are more at risk of infection.

Cultural suggestions to reduce the incidence of *Black Spot* are summarised below:

- When purchasing plants from propagators, ensure that they are free from *Black spot* infection. Procedures for testing for the presence of black spot in planting material are available at a number of plant clinics in the UK **and our guidance is that samples should be tested by growers prior to confirmation of their purchase**.
- Where possible, make use of temporary polythene clad tunnels to protect crops from wet weather conditions, thus reducing the risk of infection and spread.
- Where crops are being grown under tunnel structures, ensure that outside rows or beds of plants are set back by 1 metre from the tunnel leg (giving a total of 2 metres between the outside beds of each tunnel) to reduce the effect of soil/rain splash. Be sure to use straw mulches or Mypex permeable membrane acting as mulch along the length of the leg rows to further reduce this risk.
- Consider the installation of gutters for tunnels or other forms of water removal from the polythene, which covers the tunnel, to completely avoid rain splash onto strawberry plants. Care should also be taken to manage the run off of water from the headlands of plantations.
- Where crops are to be retained for cropping in second and subsequent seasons, remove all over-wintered trash and other crop debris from the crop in the late winter or early spring before the onset of new growth. This will reduce the quantity of Black spot resting spores which are carried over into the new season.
- Be sure to maintain good weed control as certain species are known to harbour black spot disease and provide the opportunity for cross infection.
- When controlling weeds in the growing season, avoid the use of contact acting herbicides containing paraquat (Gramoxone), paraquat & diquat (PDQ), glufosinate-ammonium (Challenge) and glyphosate (Roundup) which all encourage the sporulation of the fungus.
- In plantations that are known to be infected with black spot, aim to gain suppression and control of the disease early in the season through the use of prophylactic fungicide treatments. This will reduce the need to apply chemical control measures close to harvest.

Those crops being grown under tunnels or other forms of protection should always be adequately vented to avoid the build up of relative humidity, which could favour black spot infection. Growers should always have some means of measuring the humidity of crops grown under protection and a system that allows them to vent the glasshouses or tunnels swiftly should the humidity become too high.

Improved Crop Monitoring

One way of ensuring that agrochemicals are applied at the optimum time and only when necessary (to avoid the use of unnecessary applications), is to rely upon high quality, routine crop monitoring. Ideally, crops should be assessed at least once or twice every week for the commonly found insect pests and diseases as opposed to the fortnightly inspections that currently is the industry standard. This is particularly important early in the season. At this stage, should specific insect pests or diseases appear, then early curative and preventive action can be taken to avoid the use of applications later in the season, closer to harvest, thus reducing the risk of residues occurring.

Where such monitoring is conducted, it is wise to employ record sheets to log any problems which were found each week, record the choice of agrochemical, the date it was applied and why it was applied. At the end of the season, this allows growers to relate any residues, which have occurred to the chemical application and the monitoring procedure, thus allowing the effectiveness of the monitoring to be assessed.

Appendix 10 Control Points: Strawberries**CS.31 STRAWBERRIES**

- CS.31.1 You should be able to show evidence that when selecting fields for strawberry production you have considered soil structure, drainage, texture, pH, soil depth, exposure of the site to prevailing winds, susceptibility to spring frosts and endemic soil borne pests and diseases
- Protocol reference: Section 3.1
- CS.31.2 You must provide evidence to show that your fungicide spray programme uses the minimum number of sprays necessary for good Botrytis and mildew control
- Protocol reference: Section 8.10.2.4
- CS.31.3 All polythene waste should be recovered and disposed of or recycled in the most appropriate manner
- Protocol reference: Section 8.10.3
- CS.31.4 You should observe any additional operator and/or crop safety requirements when applying agrochemicals under protection
- Protocol reference: Section 8.10.2.4
- CS.31.5 When using crop protection chemicals, you should ensure that applications are made in a way which minimises the risks of environmental pollution
- Protocol reference: Section 8.10.8
- CS.31.6 Irrigation methods should be chosen to avoid damage to the crop during establishment and cropping
- Protocol reference: Section 7
- CS.31.7 Measures should be taken to avoid deterioration and damage of the product during and after harvest
- Protocol reference: Section 9.1