



Assured Produce

Crop Specific Protocol

BROCCOLI

(CROP ID: 60)



January 2008

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Acknowledgements

Assured Produce gratefully acknowledges the contribution of all consultees in the preparation of this protocol, particularly members of the Brassica Growers Association and Andrew Richardson, Allium & Brassica Centre, Kirton, Boston, Lincs.

Preface

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

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

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

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

All statements in this protocol containing the words "**strongly recommended**" (in bold type) will be verified during the Assured Produce assessment and their compliance will form a part of the certification/approval decision. The score required for these "**strongly recommended**" control points can be found on the final page of this document and in the checklists produced by Assured Produce licensed certification bodies.

Disclaimer and trade mark acknowledgement

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

Notes:

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

There may be other withdrawals or revocations. Products containing substances which have been revoked are shown on the PSD website (<http://www.pesticides.gov.uk>). Growers should check with their advisers, manufacturers, the Assured Produce website 'Newsflashes', the PSD website (www.pesticides.gov.uk)

Growers should comply with the 'Use up by' dates for all pesticide products. Growers should also be aware of and comply with changes on new product labels.

There may be changes for the following reasons:

- the deadline for use of NPE formulations has been extended to 31 August 2008, see <http://www.pesticides.gov.uk/approvals.asp?id=2122>
- Pesticides with NPE formulations must be used up by 31 August 2008. In many cases products will be replaced by new non-NPE formulations.
- At re-registration stage after Annex 1 listing there may be: reductions of dose rates; changes in timings and/or number of applications for some products.

In the following Appendices products and use by dates are only listed for SOLAs, and in some cases new product MAPP numbers may not be available yet.

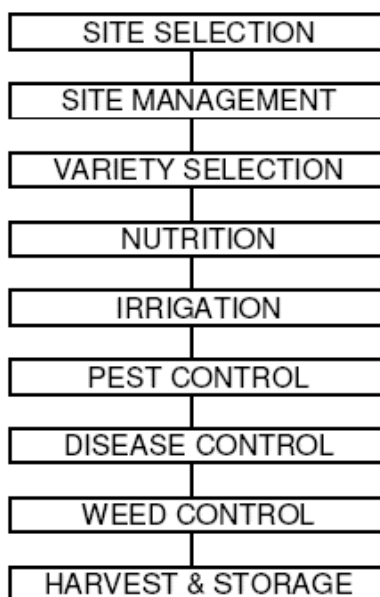
For pesticides on-label, only active substances are shown.

Any new standards have been prefixed in the text with **(NEW)**

1 General introduction

Following a systematic approach will help growers to identify and manage the risks involved in crop production. This protocol is based on a typical crop production process. Using a flowchart approach, food safety, Health & Safety, environmental and quality hazards are identified. Appropriate controls may then be established to minimise risk. Food safety and Health & Safety issues always take precedence over quality and environmental controls.

The flow chart is structured as shown below. Note that the sectional layout of both this protocol and the crop specific protocols follow the same structure.



The contents of each crop specific protocol are reviewed annually by informed farmers and growers, food technologists, scientists, the relevant fresh produce association, processors and agronomic consultants. Updated editions are issued prior to the cropping season.

The review process considers both new developments and all relevant technology which has emerged throughout the course of the previous year and which have been found to be both workable by the grower and beneficial to the environment. As one aim of the scheme is to transfer such information and technologies to growers, attention is drawn to those features of specific relevance to ICM by using *italic* script. In order that growers may be confident that they are working to a current document, each protocol is dated and numbered. 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

When selecting a site for growing a Broccoli crop it is important to consider the following requirements.

3.1.1 Climate

The crop can be grown throughout the UK. In drier areas of the South and East, irrigation may be required during periods of drought to maintain continuity. Wind erosion can be a problem on the fen soils particularly for direct drilling.

3.1.2 Weed status

Perennial weeds such as couch, docks and thistles should be controlled prior to planting/drilling a crop of Broccoli. The presence of potato groundkeepers can also be a problem to control in the growing crop.

3.1.3 Topography

Fields should be suitable for use of harvest machinery and safe for the use of spraying machinery avoiding the risk of toppling over. Use of fields sloping to the South and West should be made for early production. Avoid valley bottoms or other frost susceptible areas. In wet areas it can be advantageous to be over exposed to prevailing winds, the crop dries out quickly and helps reduce the spread of spear rot.

3.1.4 Position

Access

Easy access into the field is necessary to facilitate the use of spraying and harvesting machinery.

Pest havens

Avoid heavily wooded field margins and wasteland, where pests such as rabbits, hares and pigeons can devastate crops. Also any rodent colonies should be identified and controlled.

Obstacles

Pylons, telegraph poles, walls and fences make it difficult to operate spraying and harvesting machinery without crop damage.

Spraying safety

- a. To humans: where possible avoid cropping areas adjacent to schools, housing estates, playing fields etc. where there is a risk of drift from spraying operations.
- b. To flora: avoid areas adjacent to wildlife reserves, sites of specific scientific interest. Note the position of any beehives.
- c. To watercourses: buffer zones now apply, where the spraying of certain pesticides using ground-based vehicle mounted/drawn sprayer, is prohibited within 5m of the top of the bank of a watercourse. Protocol operators should be aware of 'LERAP' regulations introduced in 1999. Further information can be obtained from local NFU offices (see Generic Guidance Notes 8.5.5).

3.2 Rotation

Crop rotation can be used to assist with crop health in conjunction with other practices.

Club root is a problem in some brassica production areas particularly on naturally acid soils. Production in these areas should be based on a wider rotation of four to five years between brassica crops together with a well-planned liming policy. However certain areas are uniquely placed for a frost-free climate enabling good early production, requiring a balanced approach to be taken.

Brassicas thrive best on moisture retentive high alkaline situations and often continuous production can be sustained without detriment to crop quality or to the environment. In such cases growers must be able to justify their rotation with consideration to the following:

- a) *Crop health*
- b) *Avoidance of disease carry over by incorporating post harvest residues quickly and efficiently.*
- c) *Satisfactory record of pH levels and liming policy*

4 Site management

4.1 Soil mapping

See Generic Standards and/or Generic Guidance Notes.

4.2 Soil management

Soils

The Broccoli plant is not deeply rooted and some varieties have a particularly shallow root system. The crop can be grown successfully on a wide range of soil types, provided they are well drained and of good structure and without any impediment to root development such as a soil pan imposed by poor cultivation techniques. Light sandy soils favour early production but irrigation is essential on these soils, to guarantee good plant establishment (whether from direct drilling or transplanting), subsequent growth and development in the summer period.

A pH level of 7.0 to 7.5 is required, particularly where club root may be a problem. Over liming is wasteful and can cause temporary 'lock-up' of some nutrients such as manganese and boron. Lime should be applied well before planting/drilling if possible. As lime takes many months to balance soil acidity it is not advisable to grow any brassicas where liming has recently been undertaken in very low pH situations. One should also consider the damage caused by harvesting on heavier soil types particularly in wet conditions. The heavier soil types may also be difficult to obtain a good tilth for drilling in March or April.

Broccoli requires moisture throughout its growing period. Direct-drilled Broccoli is sensitive to soil surface capping, which can reduce and delay germination and disrupt uniformity of emergence, causing uneven maturity at harvest. Drill press wheels, rolling and irrigating after sowing can contribute to this problem, especially on soils of weak structure or low organic matter.

Cultivations

Whether the crop is drilled to a stand or transplanted, firm soil with a good tilth is required. Timely cultivations are important, particularly on fine, sandy, or silty soils that have a weak structure and low organic matter content. On the lighter soils late ploughing with the minimum of cultivations, will help to maintain soil structure. *Wheelings, from pre-sowing or planting cultivations, may cause compaction; therefore the bed system is to be commended. In large-scale production the tramline system, where two rows are left out for the passage of a tractor with wide tyres, facilitates easy fertiliser application, spraying, irrigating and harvesting machinery access, in addition to confining wheelings to a designated area.*

Loss of soil structure in the surface layers, due to excessive or inappropriate cultivations, can lead to soil capping and reduced emergence. In particular excessive soil working, with reciprocating tines used at high speeds, should be avoided.

4.3 Soil fumigation

See Generic Standards and/or Generic Guidance Notes.

4.4 Substrates

See Generic Standards and/or Generic Guidance Notes.

4.5 Drilling and transplanting

4.5.1 Plant populations

Plant population has important effects on:

- a. Total yield.
- b. Spear size and weight for market outlets. The higher the plant population, smaller the head.
- c. Spear quality.
- d. Costs of production.

Wide spacings are more economical for transplanted crops. Wide spacing, and the correct variety encourages air movement throughout the crop which helps mitigate low levels of spear rot and downy mildew, and slows down their spread.

4.5.2 Sowing

Generally high-density crops are sown direct to a stand. Graded high vigour seed should be used to get a good plant stand. There is no advantage in using pelleted seed.

Vacuum or belt drills cause less damage to the seed than cell wheel drills.

Ground wheel drive is superior to unit wheel drive allowing drilling to continue when the soil surface is wet. Adjustable land wheel drive may be required on some bed systems.

When drilling into soil liable to cap, minimum pressure should be applied over the rear wheels of the drill. Also, drill accessories should be considered, e.g.

- a. **Anti-capping wheels.** Twin rear wheels that run on each side of the row with a 25 mm gap between, so that the soil is not compressed directly over the seed.
- b. **Cage wheels.** They have expanded metal surfaces instead of the standard steel band
- c. **Small rakes.** Fitted behind each rear wheel to loosen the consolidated topsoil without disturbing the seed.

Shallow drilling, together with pre-drilling irrigation if necessary, is preferable to drilling deeper to reach moist soil. Avoid deep drilling on soils liable to cap.

4.5.3 Transplanting

Propagation

Broccoli does not respond well to bare-root transplanting. The majority of transplanted crop is grown from glasshouse raised modular transplants or small peat blocks. Transplanting is a major aid in crop scheduling. The modular trays, the most common size having cells of 14 ml volume containing peat compost, enable the propagator to have complete control over plant growth. Trays also provide a system that facilitates the application of a cabbage root fly insecticide treatment prior to despatch. This

uses less active ingredient per hectare than field applications. (See Appendix 4.)

To ensure the best chances of good establishment, growers should ensure that transplants are:

- Strong and well rooted in the module
- Transplanted when plants are ready and not left too long in module
- Adequately drenched for cabbage root fly where necessary
- Are free from pest and disease
- Are fully soaked and primed with nitrogen immediately prior to planting

Soft, floppy plants are undesirable and can have adverse effects on establishment.

Plants should be given a high nitrogen feed prior to despatch. Growers, especially those without irrigation, should ensure that the modules are at maximum water holding capacity at planting. (Avoid over-watering as this can leach out cabbage root fly insecticide.) It is advantageous for the grower to have modules analysed routinely to check whether the propagator has applied the correct rate of cabbage root fly insecticide. This is especially important prior to the peaks of first and second-generation cabbage root fly. For those with irrigation, if the soil is dry, or the weather hot or windy, water should be applied immediately post planting.

Propagators

Under EU Plant Health Regulations, propagators must be registered with the Plant Health and Seeds Inspectorate (PHSI) of DEFRA, plant passport details may be incorporated on the delivery note or invoice.

It is strongly recommended that to comply with the requirement of due diligence throughout the food distribution chain, details of all pesticides need to be agreed and recorded by the propagator and passed to the grower. Applications of liquid feeds should be treated similarly.

4.5.4 Early production under covers

Production under cover needs to be on easily worked soils with excellent structure and, with the exception of the silts, irrigation must be available.

Wide sheets, 10-14 metres wide, of clear perforated polythene are the most economical form of covering. There is a disadvantage with narrow sheets due to "edge effect". Before laying plastic, it is important that plants are strong enough to carry the weight of covers. Alternatively, plant in shallow ridges so that soil may support the cover for a time.

The activity of herbicides under plastic film can be erratic. This may be due to high light intensities and warmth causing accelerated breakdown, or possibly by the drying out of the soil surface. In order to improve the performance of the herbicide it is important that the herbicide is applied to a moist soil surface, or on soil moistened before the crop is covered with film.

Physiological problems soon arise if covers are left on too long. Therefore, uncover when heads of 10-15 mm in diameter are visible. If weather conditions are hot and humid, however, it is worth sacrificing advancement for less disease problems by removing the cover slightly early.

Covers should be removed on a dull day or in the late afternoon period.

By using polythene film skilfully, early cropping can be advanced by 14 days. The cost of plastic and associated laying and removal is expensive and can only be justified on early crops that achieve a monetary premium.

Disposal of plastic

*To comply with legislation, and protect the environment, plastic must not be burnt. It is **strongly recommended** that old polythene be despatched to a recycling company or disposed of in a registered landfill site.*

5 Variety selection

None of the commercially important varieties at present have resistance to the three major diseases, spear rot, downy mildew and club root. Flat-headed varieties, with large beads and low wax levels, tend to succumb quicker to spear rot. Some varieties, under certain conditions, can be susceptible to hollow stem

Provided they have good commercial qualities, future disease resistant varieties should be included in any integrated crop management system.

6 Nutrition

6.1 Nutrient requirements

Macro-nutrients

Excessive use of macronutrients is not only wasteful, but can be costly and can have a detrimental effect on groundwater supplies.

Nitrogen in particular must be tailored accurately to the precise needs of the Broccoli crop. Excess nitrogen must be avoided because:

- a. The crop does not need it - even in dry conditions there is no advantage in applying extra nitrogen.
- b. Maturity can be delayed.
- c. Soft unbalanced growth results in increased damage when handling, poor shelf life and increased susceptibility to disease.
- d. It contaminates groundwater supplies, possibly introducing a health risk to drinking water and exaggerates eutrophication.

It is **strongly recommended** that 'WELL N' or similar nitrogen prediction models are used, as they can be an efficient aid to nitrogen management.

When using 'WELL N', soil samples should be taken prior to each crop to determine the soil mineral nitrogen content and analysed for nitrate and ammonium content.

'WELL N' takes into account the residual nitrogen in the soil and the amount of nitrogen released from the organic breakdown of the previous crop residues, and predicts the total nitrogen required. Residual nitrogen testing thus enables applications to reflect accurately the Broccoli crop's need, taking into account soil residues, thus reducing the opportunity of excess nitrogen leaching into ground water.

If it is not possible to undertake a soil analysis, a soil nitrogen index should be used, which takes into account the previous crop and manuring. (See Appendix 3).

On intensive brassica land, where samples are being taken frequently for soil nitrate determination, it is cheap and economical to simultaneously analyse for pH, phosphate, potassium and magnesium. Otherwise, in the absence of crop failure, the field should be sampled and analysed at least every three years. Interim nutrient status can be evaluated using a balance sheet method.

It is **strongly recommended** that when planning fertiliser applications, soil type and variety are taken into consideration. Nutrients should be applied according to soil analysis. Typical fertiliser recommendations are given in Appendix 2.

Establishment of both drilled and transplanted crops can be adversely affected by excessive levels of fertiliser salts, especially nitrogenous fertiliser, in the seedbed. The risk of poor results from high salts is less for transplants than for seed.

Where high rates of potash are also required, the total nitrogen and potassium application prior to drilling, should not exceed 190 kg/ha; the base nitrogen level may be reduced to 50 kg/ha, and the remainder of the potassium should be applied well before drilling, (in the winter if possible) and well cultivated into the soil.

Nitrate Vulnerable Zones

Certain vegetable production areas within the UK may be located in designated Nitrate Vulnerable Zones (NVZ). These are areas where growers are asked to observe a programme of measures, designed to reduce nitrate loss from the land and help reduce nitrate levels in water.

Key action points relevant to brassica growers are:

- i. Do not apply inorganic nitrogen fertiliser between 1 September and 1 February unless there is a specific crop requirement during that time.
- ii. Do not exceed crop requirement for quantity of nitrogen fertiliser on each field every year, taking account of crop uptake and soil supply from soil organic matter, crop residues and organic manures.
- iii. Application of organic manures should not exceed 190 kg/ha of total nitrogen averaged over the farm area each year
- iv. Do not apply fertiliser or manures when the soil is: water logged, flooded, frozen hard or covered in snow
- v. Consider a cover crop to use up excess nitrogen over the winter months, ryegrass, is a good choice, as it does not involve a 'green bridge'. Sowing must be completed before September 15th to be of any value.

Trace elements

These should only be applied when deficiencies are evident according to analysis, with crop growth and development appearing to be reduced. In the absence of adverse symptoms, a healthy looking crop may not need foliar application of trace elements. On most soils trace element problems are unlikely.

pH

In common with all horticultural brassica crops the soil pH for Broccoli should be maintained at 7.0 to 7.5. Although this can cause problems where potatoes are grown in the rotation.

7 Irrigation

Plants under drought-stress tend to be susceptible to pest attack.

Where available, apply 25 mm irrigation at 25 mm soil moisture deficit.

Irrigation should cease approximately 20 days before cutting to prevent damage to the wax layers on the head therefore exacerbating potential spear rot damage, if the weather suddenly changes to wet, humid conditions. If the water supply has been limited, an application of 25 mm, 20 days before cutting, can be beneficial.

The method of irrigation should not be wasteful of water used. The source of the water used should be checked at regular intervals for contamination.

8 Crop protection

8.1 The basic approach to crop protection

See Generic Standards and/or Generic Guidance Notes.

8.2 Plant protection product choice

See Generic Standards and/or Generic Guidance Notes.

Approved uses not included on the product label

In some circumstances product labels do not include all of the approved uses and growers and advisers wishing to check the approval notice of a particular product should note that this information is available from www.pesticides.gov.uk/psd_databases.asp

A search on the database for a product name should yield a results page. A click on the product name should link to a summary of the approval information. At the bottom of the summary are links to available notices, which will give the statutory conditions of use.

In the case of products with older approval an electronic approval may not be available. In these cases growers should contact the PSD Information Services Branch for details of the approved conditions of use.

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

8.3 Advice on the use of pesticides

See Generic Standards and/or Generic Guidance Notes.

8.4 Application of pesticides

See Generic Standards and/or Generic Guidance Notes.

8.5 Records of application

See Generic Standards and/or Generic Guidance Notes.

8.6 Protective clothing/equipment

See Generic Standards and/or Generic Guidance Notes.

8.7 Pesticide storage

See Generic Standards and/or Generic Guidance Notes.

8.8 Empty pesticide containers

See Generic Standards and/or Generic Guidance Notes.

8.9 Pesticide residues in fresh produce

See Generic Standards and/or Generic Guidance Notes.

See Generic Protocol Guidance Notes 8.9 for further background and generic advice.

Assured Produce is aware that a key area in the production of fresh produce which requires continued attention by growers and their advisers is that of keeping pesticide residues to a minimum. 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 13 for the pesticide targets and guidelines on this crop.

8.10 Pest, disease, physiological disorders and weed control

8.10.1 Pest control

The main principle, with the exception of cabbage root fly, is that control measures should only be applied when the pest is present. Routine applications of insecticides at set time intervals, is not the correct approach. Prevention is better than cure, therefore where possible, an integrated approach is needed.

Prevention:

- i. *Management and planning: Where geographical and agricultural factors permit choose sites away from existing brassica and rape production to avoid a continuous 'green bridge' throughout the year. Plough in crop residues immediately cutting ceases.*
- ii. *Crop rotation.*
- iii. *Provide good soil structure, correct nutrition and irrigation if possible to ensure conditions that give good strong, healthy growth.*

Control:

- i. *Use available pest forecasts as management tools to aid when to scout for pests.*
- ii. *Regular, systematic crop walking to monitor crop development, pest and disease levels. Increase frequency of crop walking during periods of high pest incidence particularly during hot weather.*
- iii. *In addition to crop walking, use of insect traps e.g. pheromone traps, chemical attractant traps and soil sampling (cabbage root fly eggs) as monitoring tools.*
- iv. *Once validated in the field, the use of tolerance levels may be introduced for cabbage aphids and caterpillars.*
- v. *Identify both pest and naturally occurring predators, to determine whether necessary to apply control measures and where possible use selective pesticides to reduce impact on naturally occurring predators and beneficial organisms. However, choice must be weighed up against efficacy and longevity of treatment. Use the least toxic product where possible.*
- vi. *Resistance is building within aphid population's particularly peach potato aphids. It is important to alternate active ingredients to enable the best chance of control with the existing range.*
- vii. *Use the minimum effective dose rate, normally being that recommended. Do not reduce does rates for peach potato aphid.*
- viii. *Consider the use of natural and biological methods of pest and disease control, if available.*
- ix. *Avoid spraying or allowing drift into grassy banks, dyke sides, hedgerows etc. as they provide reservoirs of insect predators e.g. ladybird larvae, hoverflies, ground beetles etc. However, also*

consider the implications of buffer zone restrictions on certain chemical uses.

- x. *Carefully consider the anticipated harvest date when selecting the most appropriate product. Ensure you have enough time for the harvest interval to elapse prior to harvesting.*

The use of some approved pesticides may not be acceptable to processors. In order to conform to the requirements of the processors proposed applications should be confirmed with the contracting company.

Section 8.10.1 reviews the main brassica pests in the UK. A review of the minor pests can be found in Appendix 1.

8.10.1.1 Cabbage root fly (*Delia brassicae*)

Even light attacks by larvae, which feed on the roots, can reduce yield. Severe infestations cause stunting, bluish or red discolouration of the leaves and the plants may wilt and die. Larvae occasionally tunnel into the spears, seriously affecting the quality. There are two or three generations each year, starting from fly emergence and egg laying in late April-early May and extending, with some overlapping, into September. Preventive treatments are essential prior to the peak of each generation, irrespective of whether the crop is direct drilled or transplanted.

The eggs of cabbage root fly are attacked by several beetle species. These beetles remain in the soil for long periods and their numbers can be reduced by insecticides applied to other crops in the rotation.

Forecasting/monitoring

Present monitoring methods include counting eggs laid at the base stem to predict the size of the next generation of larvae and non-selective water traps that catch adult flies. An HRI computer prediction model gives the timing and duration of populations based on statistical information and local weather data.

A chemical attractant trap is available that selectively traps adult flies and thus, in future, a combination of this trap and the HRI computer prediction model may give a more reliable monitoring system.

Control methods

Direct-drilled crops

On crops drilled before mid-April treatment should be delayed until late April or if later the two true leaf stage. Apply either granules (as a band application) or a spray (overall or band). Currently approved insecticides are listed in Appendix 4.

On crops drilled after mid April an insecticide should be applied before or at drilling. Apply granules at drilling as a bow-wave treatment, or apply an overall spray followed by shallow (<7.5 cm) cultivation just prior to drilling, or a band spray immediately in front of the drill. *Applicators should be calibrated before use.* Check product label for comments about the use of granules on certain soil types (e.g., high organic matter, high pH etc.) and under dry soil conditions.

Plant propagation

- a. Pre-planting drenches

Chlorpyrifos or spinosad can be used as a pre-planting drench on block and module raised plants. Do not use on cells smaller than about 14 ml capacity.

Chlorpyrifos must not be used to treat blocks/modules which will be planted out before April 1st. When

drenching with chlorpyrifos, ensure it does not become washed or leached into glasshouse soils. Where plants are treated outside glasshouses, safe disposal of all run-off liquor is required. Where chlorpyrifos drenches are used, subsequent applications of pesticides in the glasshouse or in the field should be delayed until adequate wax has formed on plant leaves.

- b. Seed treatment with chlorpyrifos (Gigant[®])

It is recommended that growers consider the use of this treatment as the levels of active ingredient used are minimal resulting in considerably lower operator exposure and far less active ingredient is incorporated into the soil. Note: the EU approval for Gigant has expired. Treated seed, where available, may still be used for 2008 cropping.

It is **strongly recommended** that growers consider the use of seed treatments, where available, in preference to module drenches or granule treatments for the control of Cabbage Root Fly.

Transplanted crops

Crops grown from block or module raised plants, which were treated before planting, should not normally need further treatment in the field; however, there are occasions where subsequent treatment may be necessary:

- a. Where, due to planting delays, considerable irrigation was applied on the nursery and time elapsed before planting, which may have led to leaching of the insecticide.
- b. Insufficient insecticide applied by propagator (advisable to maintain a check at planting by routine analysis of compost).
- c. Early in the season, when the incorporated treatment is not persistent enough to protect the young plants up to the first peak of egg laying.
- d. In the absence of irrigation, when upper layers of the soil are dry or soil conditions are cloddy, it is essential to plant deeper in search of moisture for the plants to survive. But this necessitates covering the module with soil and thus renders the stem at soil surface level open to attack.

Granules can be applied at planting, either as a sub-surface treatment, using a 'Leeds' type placement coultter, or as a band along the row within 2 days of planting. With post planting treatments, avoid excessive lodging of granules on the foliage which may cause phytotoxicity, this is especially relevant when the foliage is wet during treatment. From both an environmental and efficacy point of view, sub-surface treatment is preferred.

Treatment techniques

Granules

Band treatment gives the most efficient placement and is recommended for all granules, but recommendations may specify the exact method to be used, (e.g., surface band or bow wave, width of band etc.) Applicators must be calibrated in the field before use.

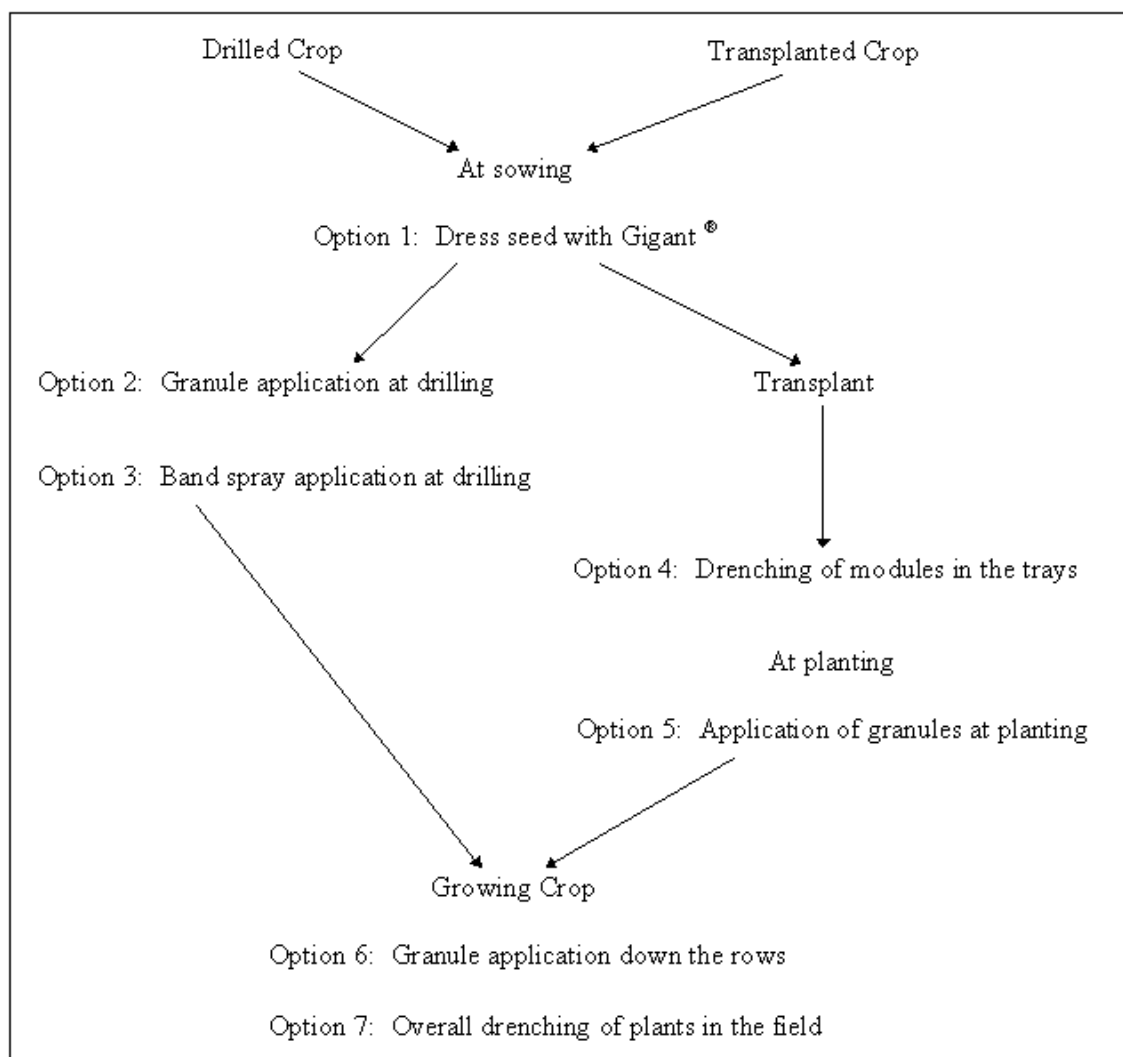
Recently, increases in the speed of degradation of some soil-applied granules have been observed and the persistency of the product may possibly be much shorter than that quoted by the manufacturer.

Sprays

Should only be used in areas of low cabbage root fly activity. Time of application is stipulated on product label.

Larvae occasionally tunnel into the spears seriously affecting quality.

Cabbage root fly control summary



8.10.1.2 Aphids (*Brevicoryne brassicae* and *Myzus persicae*)

This mealy grey aphid is an important and widespread pest of Broccoli. Growth of young plants is checked occasionally followed by wilting and death in dry conditions. On older plants, infested leaves curl and turn yellow and the spears may be spoiled with contamination by aphids.

Invasion occurs from April to July and, in favourable weather, build up of aphids is greatest from July to October. Crops should be examined regularly from April onwards and treated when aphids are found.

There are two species of aphid which are of commercial relevance:

Mealy grey aphid (*Brevicoryne brassicae*)

Widespread pest of Broccoli, which checks the growth of young plants resulting in wilting and possible mortality, particularly in dry conditions. On older plants leaves curl up and marketable quality is spoiled by contamination with the aphid colonies.

All stages, including eggs, occur on stems and leaves of winter hosts (usually other cruciferous species) winged

forms migrate to summer hosts from May/June onwards resulting in an early peak during July followed by a population crash. This is followed by a second, often higher peak in September/October. Early identification and treatment is essential as once colonies become established control is much more difficult and spoilage is inevitable.

Peach potato aphid (*Myzus persicae*)

Becoming more important of late, particularly in warmer, drier seasons, this aphid can be present in fairly high numbers affecting marketable quality. It doesn't normally form dense colonies and overwinters as adult and immature stages, on winter brassicas and Beet crops together with many herbaceous plants outdoors and under glass. Winged forms migrate to summer hosts in May and June reaching peaks similar to those of the mealy grey aphid. The pest is an important vector of many plant viruses.

Four insecticide resistant mechanisms exist in UK populations; metabolic - conferring resistance to organophosphates; modified acetyl-cholinesterase (MACE) conferring resistance to carbamates and; knock-down (KDR) and Super KDR both conferring resistance to pyrethroids. No current resistance mechanisms exist with regard to the neo-nicotinoids i.e. imidacloprid (Gaucho®) and thiacloprid (Biscaya®) pymetrozine (Plenum®) or nicotine. Use of these four actives should be made where there has been a previous history of resistance or where resistant populations are suspected.

Cultural control: *Most cabbage aphid infestations develop from colonies that overwinter on old brassica crops and autumn sown oilseed rape. Plough in or otherwise destroy such crop residues.*

Aphid populations can be reduced by a multitude of insect predators including ladybirds, hoverflies and parasitic wasps. Crops should be walked regularly to determine the balance of predators in relation to plant size etc., to determine whether the crop actually needs spraying, or whether the predators will naturally take care of the aphids. Many factors are involved in this biological 'integrated' approach and the risk associated with the various crop-walking techniques are being determined by HRI currently.

Chemical control: Numerous insecticides are currently approved for use (see Appendix 5). *Select insecticides with the least harmful effect on beneficial insects and avoid broad-spectrum insecticides.* Some synthetic pyrethroids, despite their reputations, often kill a wide range of beneficial predators.

Choose to alternate insecticides from different chemical groups, in order to avoid build-up of aphid resistance. Weather conditions and time of year should be taken into account when selecting the aphicide e.g. late in the season from October onwards, control of cabbage aphid with pirimicarb, may fail and during dry periods the uptake of systemic insecticides is reduced.

Current work at HRI is creating forecasting techniques for aphid populations. Studies of populations show a regular midsummer "crash" where natural mortality is actually greater than by applying aphicides. This normally occurs in late July - early August.

8.10.1.3 Caterpillars

Caterpillars of many species attack brassicas and may appear at almost any time between mid May and harvest, although the degree of infestation varies from season to season. The damage caused depends upon the species responsible, both leaves and spears may be eaten, the spears may be fouled with droppings or the presence of caterpillars in the head makes the product unmarketable. Some species, when nearly mature, are difficult to kill with insecticides and cause considerable spoilage. *Other species, even when numerous, may not justify treatment.* The caterpillars of the diamond back moth feed on the undersides of leaves, leaving the upper surface as a 'window pane'. Now becoming a common pest, it can have several generations in a season. If control is necessary, insecticides should be applied whilst the caterpillars are still young. To help in crop walking and establishing thresholds pheromone traps are available to catch adult moths.

Cultural control: *Frequent crop walking is essential to identify both the caterpillar species and natural*

predators. Some predators are capable of destroying every caterpillar in the population. Also some caterpillar species only have one generation per year and thus if the feeding is at low levels on the vegetative parts of the plant, when no spears are visible, chemical control may not be necessary.

Chemical control: Check crops regularly and apply insecticides only when caterpillars are found. A list of currently approved insecticides is given in Appendix 6. Treatment of crop headlands and the field periphery may be sufficient, as the adults tend to move into the field from the field margins.

Wherever possible use specific control measures involving *Bacillus thuringiensis* or diflubenzuron, that have a less damaging effect on beneficial predators than broad spectrum pyrethroid insecticides.

8.10.1.4 Cutworms

Cutworms are the caterpillars of several species of noctuid (night-flying) moth; the most important of which is the turnip moth (*Agrotis segetum*). The young caterpillars hatch in June and July, feed on the foliage for at least a week, before descending to feed on the underground parts of the host plant.

Cutworm attacks are most severe in hot dry summers; routine treatment is not required. Warnings are issued based on trap catches sometimes combined with a weather model to define 'high risk' periods, when the caterpillars are small and can be controlled by rainfall/irrigation or chemical treatment. Use pheromone traps to monitor moth numbers. If local information is not available and irrigation is possible, apply at least 20mm of water as advised by the cutworm warning. In absence of rainfall or irrigation, control with a pyrethroid insecticide, timed as recommended by the spray warning.

8.10.1.5 Pollen beetle

Adults, dispersing principally from oilseed rape, can damage brassicas in summer. They are capable of inflicting damage to the quality of Broccoli heads.

Cultural control: *A forecasting service is already available to HDC members that will predict the onset of migration of pollen beetles. This should alert growers to start field monitoring. Simple yellow sticky traps set slightly above the crop level will adequately indicate the level of this pest.*

Chemical control: If beetles are found damaging the crop or are likely to contaminate harvested produce, apply an insecticide with a recommendation for application to leaf and flowerhead brassicas. Pyrethroids should be particularly considered because of their subsequent repellent effect. Best timing is immediately after a harvest to allow control before the next cut is due; frequency will depend on pest pressure. Re-inspect crops frequently.

8.10.1.6 Slugs

Slugs damage brassica seedlings and established plants on medium to heavy-textured soils in wet seasons; Broccoli curds may be grazed. Slugs are occasionally taken with produce into the processing factory.

Cultural control: *Consolidate soils to inhibit slug movement where necessary. Surface bait using bran to determine need and timing of further control measures. Avoid using slug pellets for baiting as localised concentrations can have adverse effects on wildlife.*

Chemical control: Broadcast affected areas with an approved molluscicide if trap catches and weather pattern indicate a period of high risk. Aerial applications are permitted and have given good results. See Appendix 10 for a current list of approved molluscicides.

Metaldehyde has been shown to preserve populations of ground beetles, which are beneficial in other areas of pest control. Repeated doses of pirimicarb used in aphid control have also been shown to

reduce slug damage.

8.10.1.7 Cabbage stem weevil (*Ceutorhynchus quadridens*)

A widely distributed but sporadic pest that attacks all cruciferous crops particularly direct drilled Brassica crops. The larvae feed in stems and petioles of plants that may subsequently wilt.

Some granular treatments applied for cabbage root fly give incidental control.

8.10.1.8 Beneficial organisms

Beneficial organisms include predators, parasitoids and disease. Although a great deal of research has been undertaken regarding the biology and behaviour of natural enemy species, relatively little is known about the numerical impact that they have on pest populations in commercial brassica crops.

Natural enemies of pests can themselves be attacked by predators, parasitoids and disease; which may limit their effectiveness. They can also be affected by the use of agrochemicals, which may cause mortality, have sub-lethal effects on development or behaviour, or suppress disease outbreaks.

Finally, with cases of direct pest damage, natural enemies are often effective only after the crop damage has been done. The presence of some natural enemies in produce may also at times cause contamination issues for growers.

Predators

Specific predators - such as ladybird larvae and adults and hoverfly larvae consume only aphids. They are able to consume large numbers of aphids but may be present in crops only at certain times of the year.

Generalist predators - Many predators consume a wide range of pest and non-pest species. Generalist predators include species of beetles, spiders, mites, harvestmen, lacewings, flies, earwigs, ants, bugs, wasps and vertebrates such as birds and small mammals. It is estimated that, in cereal fields, there may be about 400 species of generalist predator. Laboratory studies have shown that some predators are able to consume large numbers of pests. However, predation rates in the field will depend upon how often particular pests are encountered and whether there are alternative sources of food. Some species, such as ground beetles, eat both live and dead material.

Parasitoids

Parasitoids spend their larval stages as parasites, feeding on host tissue and killing the host in the process. They tend to be fairly specific, although some species will, for example attack several species of aphid.

The cabbage root fly is attacked by two main parasitoids, a wasp and a rove beetle. The adult rove beetle is also a predator. Rates of parasitism vary from crop to crop and are reduced usually when non-specific insecticides are used.

Cabbage aphids have only one parasitoid, the small wasp, *Diaeretiella rapae* which also attacks the peach potato aphid. The life-cycles of aphids and their parasitoids are closely linked. Again, levels of parasitism vary between crops and may be affected by insecticide use.

Caterpillar pests are also attacked by a range of parasitoids, mainly wasps and flies. These may cause significant mortality in species such as the diamond-back moth.

Diseases

Insect pests may be attacked by a number of bacterial, fungal and viral diseases. Aphids and adult cabbage root flies appear to be particularly susceptible to fungal diseases, whilst caterpillars are more susceptible to bacteria and viruses. Fungal diseases can be particularly devastating, but may be triggered only when environmental conditions are favourable.

Exploiting beneficial organisms

1. Monitor crops regularly to determine the balance of insect predators in relation to pest numbers and plant size to determine whether to apply a pesticide or not.
2. If a pesticide is required avoid use of broad spectrum insecticides which can have a harmful effect on beneficial insects.
3. Consider the use of biological control agents such as *Bacillus thuringiensis*.

For further information on beneficial organisms contact Mrs R Collier, Warwick HRI.

8.10.2 Disease control

Introduction

Broccoli is subject to many of the diseases that attack brassicas. In modular plant propagation under glass, seedling diseases are common and consistently damaging, thus requiring routine treatment. *Regular monitoring during propagation and crop walking in the field, coupled with correct identifications of diseases, is an important element in minimising fungicide use.*

Where possible, the guiding principle is that pesticide inputs should be minimised through prevention rather than cure. Where possible an integrated approach is needed, involving the following management steps:

Good management and planning

- a. *Careful site selection. Where possible avoid known potential or previous problems, thereby enhancing plant health. If possible, site away from crops such as oil-seed rape and other brassicas. In intensive brassica areas, where this is not possible, plough in plant remains immediately as harvesting ceases, to prevent spread of diseases such as mildew, etc.*
- b. *It is good agronomic practice to rotate crops to prevent the build up of soil borne diseases. In intensive areas this is not possible, therefore agronomy and disease monitoring must be of a high standard.*
- c. *Use resistant varieties (where available) whilst respecting the need to meet the required agronomic, quality parameters and eating requirements.*

Cultural control techniques:

- a. *Plant propagation under glass, goes a long way to reducing the incidence and severity of seedling diseases, especially downy mildew.*

Irrigate plants in the morning, or soon enough to allow leaves to dry off before the night. Avoid over-watering, as this both washes nutrients and crop protection chemicals out of compost, and creates favourable conditions for damping-off pathogens. The amount of time seedlings are allowed to sit wet in the glasshouse should be kept to a minimum.

*Maintain adequate ventilation to prevent the creation of a still, humid environment around seedlings. Control feeding to prevent over-soft growth. Adequately sterilise trays to prevent carry-over of diseases such as club root, *Pseudomonas*, damping-off, etc.*

- b. *In the field, apply nutrients according to soil analysis.*
- c. *Encourage steady growth by ensuring regular supply of water, where possible.*
- d. *Through good agronomy, provide good growing conditions, i.e., avoid poorly drained soils and the presence or imposition of soil pans.*

Chemical control:

- a. Regularly field walk and monitor the crop for diseases, in conjunction with monitoring pests, to establish the need to take corrective action and refer to thresholds where established. Regular monitoring, both during propagation and in the field, coupled with correct identification of diseases, is an important element in minimising fungicide use. The decision whether it is worthwhile to apply fungicides must consider the disease, time of year, degree of infection and nearness to harvest. The effect of prevailing weather conditions should also be considered.

*Computer prediction models have been developed at HRI for Alternaria, ringspot and white blister and are now in widespread commercial use. In the field, it is **strongly recommended** that fungicide use is justified and fungicides are not applied on a routine prophylactic basis .*

(Revised)

- b. Where fungicidal control is required the following points should be considered, whilst ensuring effective control is achieved:
 - o Use the least toxic and persistent product.
 - o Use the minimum effective dose rate.
 - o LERAP - check that use within 5 metres of the top of the bank of watercourses is approved.
- c. Carefully consider anticipated harvest date and ensure the chemical selected has an appropriate harvest interval.

8.10.2.1 Club root (*Plasmodiophora brassica*)

This affects all vegetables of the Cabbage family and a number of ornamental cruciferous plants and weeds, including charlock and shepherds purse. It causes swelling of the roots which subsequently rot; the leaves turn purple/blue and wilt, the plant may be stunted or even die. It is of considerable significance in some brassica areas, particularly where soil pH is naturally marginal. Resting spores of the fungus remain viable in soil for at least twenty years.

Cultural control:

- i. *Consider clubroot resistant varieties where available*
- ii. *Wide rotation as possible in vulnerable areas.*
- iii. *Soil tests can give a guide to potential infection. Sample at least 3 - 4 months before anticipated planting date to allow change of cropping.*
- iv. *Liming to maintain a soil pH 7.0-7.5 gives good control, but there is no cure once plants are affected. In susceptible areas, patches, (usually of lower pH) of club root can occur. These small areas should be limed separately.*
- v. *High pH levels can give rise to minor nutrient problems.*
- vi. *In dry times, plants suffering from a small infestation can be brought to marketable yield by copious irrigation.*
- vii. *It is essential to use disease-free modules.*
- viii. *Liming will not work immediately, it should be part of rotational planning.*

Chemical control: None available.

8.10.2.2 Damping off and wirestem (*Pythium* spp. and *Rhizoctonia solani*)

These fungi attack the roots and stems of young seedlings and can cause serious losses during glasshouse propagation and occasionally affect drilled crops in the field. With *Rhizoctonia* in the field, the stem base becomes hard, brown and shrunken and the plants usually break off later in the season.

Pythium is best controlled at propagation in the glasshouse with fungicides used pre-sowing or pre-planting as preventative treatments. For both diseases treatment of field crops is impractical.

Cultural control:

- i. *Good glasshouse hygiene is essential*
- ii. *Good glasshouse management as outlined in Section 8.10.2 (Introduction), above.*
- iii. *Use plastic modular trays rather than polystyrene. The former can be sterilised easier and more effectively. When the surface coating wears off polystyrene trays, roots and fungi can penetrate the polystyrene and become a reservoir of disease.*

Chemical control: Fungicides approved for use in propagation both as pre-sowing drenches or pre-planting treatments listed in Appendix 8.

8.10.2.3 Downy mildew (*Peronospora parasitica*)

An endemic disease in propagation under glass but can attack outdoor crops in the autumn.

Yellow-brown areas develop between the veins on the upper surface of the leaves corresponding with white/grey fungal growth on the under surface. Severely attacked leaves turn yellow and die off. The fungus may also cause black streaks to appear on the spear. Running down stems it produces a browning which can look like insect damage.

The practicalities and economics of treating maturing crops may be questionable, but in wet weather the risk of damage increases and control is justified.

Cultural control:

- i. *Good glasshouse hygiene is essential.*
- ii. *Good glasshouse management as outlined in Section 8.10.2 (Introduction), is essential.*
- iii. *The crops under propagation from January to March are most at risk.*
- iv. *Varieties vary in susceptibility; therefore, choose the more resistant varieties, provided they give the other agronomic features required.*

Chemical control:

- i. In propagation, routine treatment, both on a preventative and eradicant basis, is essential.
- ii. Currently approved products are listed in Appendices 7 and 8.
- iii. Preferably alternate fungicides from differing chemical groups to avoid development of resistant strains.

8.10.2.4 Dark leaf spot (*Alternaria brassicae* and *Alternaria brassicicola*)

Mainly affects the lower leaves, causing symptoms ranging from small, black spots to large black/brown spots, mainly during propagation. These fungi are seed-borne and can be controlled by seed treatments. The disease may occasionally affect the spear, but the economics of treating maturing crops may be questionable.

Chemical control: Fungicide treatments on listed in Appendix 7.

8.10.2.5 Ring spot (*Mycosphaerella brassicicola*)

Circular grey or brown spots about 15mm diameter are formed on the leaves and stem being more frequent on the outer leaves. Very small black fruiting bodies of the fungus are dotted over the surface of the spots in concentric rings. Badly affected leaves turn black and wither prematurely. Debris of previously affected brassica crops is the main source of the disease.

Chemical control:

- i. Not common on the spear and therefore the economics of treating maturing crops may be questionable.
- ii. Currently approved fungicides are listed in Appendix 7.
- iii. Appearance of disease tends to be patchy and the low-density crops appear to be slightly less susceptible.

8.10.2.6 White blister (*Albugo candida*)

A problem that occurs in most seasons occasionally, but becoming more frequent. All the aerial parts of the plant may be affected. White, glossy patches appear initially (but later turn powdery), on the lower surfaces of leaves and on the stems. On the spears it causes individual flower buds to swell and grow above their neighbours and turn white.

Chemical control: Currently approved fungicides listed in Appendix 7.

8.10.3 Physiological disorders

8.10.3.1 Hollow stem

When the heads are harvested, the stems are seen, as the name indicates, to have hollow centres. The cause is not known and when the cavity is dry, it causes no problem with the appearance or eating quality of the head. One school of thought suggests that where the cavities are clean and there is no rotting, the trouble is caused by a nitrogen-potassium imbalance. The problem is more common in low plant populations than in high ones. Another suggestion is that the hollowness may be due to rapid growth after irrigation or rain.

Where the hollowness is accompanied by rotting, boron deficiency may be suspected. If this condition is common on the farm, boron should be applied to the soil before planting or sowing. Borax is the standard boron fertiliser and is applied at 22-26 kg/ha. However, as it is not easy to apply evenly, the commercial product Solubor[®], applied as a spray at 12-15 kg/ha, may be preferred. Boronated fertilisers can be used if they have the correct N, P, K ratio. Leaf sample analysis should take place to substantiate any treatment.

8.10.3.2 Spear rot

Potentially the most damaging problem to the mature crop, spear rot first appears as discrete blemishes on the spear, the cause of which is not known. Subsequently bacterial rots invade. Symptoms on the spears normally start as water-soaked areas that quickly develop into a black soft rot in warm and wet conditions. The bacteria involved are *Erwinia* and *Pseudomonas* species. Both bacteria are common leaf surface organisms with a very wide host range, which can multiply rapidly in wet conditions. They can survive the winter in the soil. Spread within the field is primarily by rain splash and later by insects feeding on the rotted vegetation. Although observations suggest it is worse in the flatter headed varieties, the more dome-shaped are by no means immune. There are no effective curative treatments.

Cultural control:

- i. *Bacteria can be found 12 months after crop has been ploughed in, thus crop rotation is important.*
- ii. *Varieties differ widely in their reaction to spear rot, although no varieties are resistant. Therefore, providing other agronomic factors can be satisfied, choose varieties carefully.*

- iii. *High-density crops are more at risk than low density ones.*
- iv. *High rates of nitrogen produce high rates of growth. This produces a thinner layer of wax on beads, rendering crop more prone to spear rot, therefore consider nitrogen usage carefully.*
- v. *Water deficits should be made up by irrigation before the head forms; otherwise irrigation will damage the wax layer. If the weather stays hot and dry, late irrigation will not cause harm, but if the weather changes to wet and showery, late irrigation can cause serious spear rot problems.*
- vi. *In wet weather, the crop should be picked hard as the rot appears to progress most quickly in fully mature heads.*
- vii. *Avoid sheltered fields so that the wind can dry the crop after rain.*

Chemical control: Copper oxychloride, a protectant copper fungicide and bactericide, has off-label approval (see Appendix 12). Recent research at SAC has shown that copper is best applied in conjunction with the adjuvant Designer before the spear is 10-15mm in diameter. This protectant will not eradicate an existing attack or when disease pressure is high, prevent the onset of the disease. Its best achievement has been a 50 per cent reduction in a light attack.

Preventing other diseases from attacking the head of the spear can assist in slowing down spear rot.

8.10.3.3 Strangles

This is first noticed in the field when plants fall over or break right off at soil level. The disease caused by secondary fungal pathogens, starts in seedlings and small plants, but may not be noticed until they have become much larger. The stem is constricted near the ground and often swollen above the constriction. The disease is initially brought about by injuries caused by wind or careless planting.

Cultural control: Avoid exposed locations and take care at transplanting or inter-row hoeing to avoid injuring the stem.

8.10.3.4 Brown bud

Individual buds in the developing heads turn brown and die. It is most commonly seen when a period of high soil moisture is followed by a period of high temperatures and rapid plant growth, especially at the time of bud development.

8.10.4 Weed control

The use of herbicides can be reduced considerably by attention to the following:

- a. Use of stale seedbed technique.
- b. Avoiding use of covers where resistant weeds (e.g. Pennycress) are a problem.
- c. Identifying those weeds present and targeting with the use of more selective active ingredients.
- d. Use of mechanical weeding machines frequently through the crop. These should be set to give minimal disturbance to the soil in drier conditions and so that soil is lightly thrown around the base of the stem thus "smothering" seedling weeds. New designs involving spring tines are now available to effect better control of seedling weeds within the cropping row. Provided soil conditions are not too wet this method is much preferred.

A range of soil acting residual and post emergence contact herbicides is available. Currently approved herbicides for fresh Broccoli are given in Appendix 9. Select a herbicide that controls the weed spectrum present.

For residual herbicides to work effectively a fine, firm, moist tilth is required. Cloddy soil conditions greatly reduce the effectiveness of herbicides.

9 Harvesting and storage

9.1 Hygiene

See Generic Standards and/or Generic Guidance Notes.

9.2 Post-harvest treatments

See Generic Standards and/or Generic Guidance Notes.

9.3 Post-harvest washing

See Generic Standards and/or Generic Guidance Notes.

9.4 Harvesting

Prior to harvesting, the grower needs to ensure that the statutory harvest intervals have elapsed for every chemical applied to that crop. Spraying records need to indicate a safe harvesting date (positive release date) for each application.

Harvesting constitutes a considerable proportion of Broccoli production costs, therefore, as small a number of harvests as possible should be the objective.

It is **strongly recommended** that harvested product is not contaminated by or exposed to anything that would affect food quality.

9.4.1 Prediction

Calabrese prediction models are available. The HRI/HDC computer model uses information taken at curd initiation and meteorological data to predict cutting date. Prediction models from other sources are available. Hot weather enhances maturity and reduces the cutting interval.

9.4.2 Cutting

When the heads are ready for harvesting they are as near perfect as they are likely to be, and from then on they only deteriorate. At every stage of harvesting, the process of deterioration can be speeded up by carelessness. The highest level of management skill is needed.

Although it may be possible to harvest 80 per cent of the central heads at one time in a well grown uniform crop in June to September, three or more harvests is the usual requirement. In June to August, crops usually need harvesting every 3-4 days. Later, once a week probably suffices. High-density crops usually need picking more often. *In hot weather, the crop should have been irrigated, so the heads to be harvested are fully turgid.*

With high density crops usually only the terminal heads are cut. In low-density crops, secondary heads usually mature after the central head has been cut and, if required, these are taken at later harvest. Some may be cut during a third harvest of the central heads.

Various mechanical aids are used to assist the harvesting process but, during cutting, Broccoli is at risk from physical damage such as cuts, grazes and bruises, which can speed up the post harvest deterioration, as well as affecting appearance. It is therefore essential that the method of harvesting poses the least risk of physical

damage.

Tractor-mounted wrap-around harvesting aids should be used (of the cup or belt type or similar). This enables the cutters to place the trimmed product carefully in the cup or on the belt where it is transferred to the covered trailer being towed behind the tractor there the Broccoli is graded and packed. The product, therefore, is immediately taken out of direct sunlight.

With low density crops, where the specification is for a single head (target weight 250 g each or, ranging in sizes up to over 500 g each), it is usual for the head to be stripped of leaves and packed direct into the customer's container, ensuring that unnecessary damage does not occur. This practice of field packing direct into the customer's containers leaves trimming waste in the field to be ploughed in. Preferably, Broccoli should remain in the same packaging right up to point of sale. This reduces the amount of handling and hence reduces the risk of damage.

Palletisation on the rig assists management and helps to prevent damage to box and contents.

High-density crops and sideshoots from the low population crops, destined for over-wrap posy packs, must be cut into bins and transported to a packhouse for cooling and over-wrapping.

Although harvesting is exempt from the Food Safety (General Food hygiene) Regulations, the more sophisticated packing rigs will need a hazard analysis appraisal. The FPC will shortly be publishing a Code of Practice covering food safety on field packing rigs.

9.5 Cooling

Broccoli has a very high post harvest respiration rate. Unless cooled rapidly soon after cutting, Broccoli will rapidly lose turgidity and this loss of moisture will continue until arrested by chilling. Therefore delays between cutting and the commencement of cooling should be minimised. The causes of Broccoli deterioration are dehydration, microbiological attack and physiological changes - all of which are temperature related. Cooling immediately after harvest, followed by cool chain distribution, is the most effective means of preserving quality and shelf life.

9.5.1 Cooling rate

Equipment should be capable of reducing Broccoli temperature down to possibly a minimum of 6°C in 12 hours. Cooling rates faster than this are unnecessary and require very expensive cooling equipment.

Broccoli is sensitive to chilling injury and temperatures of less than 2°C can actually reduce shelf life and adversely affect crop qualities. Ideally Broccoli should be cooled and held in conditions where the relative humidity is in excess of 95% and this should be maintained right through to the retail point of sale.

9.5.2 Cooling equipment

Conventional direct expansion refrigeration cool stores are not generally suitable unless coupled with supplementary humidification and some form of forced air ventilation.

Wet air coolers with positive ventilation such as ice bank coolers are ideal. Other suitable systems available use water to air heat exchange or inject a fine moisture mist into the cooling air as in the Hydrair method, e.g., Bitech Air-Spray, Howe-Cool and Polacell. Most refrigeration engineers can supply a suitable wet air system if they are provided with detailed information.

Ozone benign refrigerants (i.e. CFC-free) are preferred. Vacuum cooling is the fastest method and also has the advantage of being able to cool overwrapped and packaged produce. Once cooled Broccoli must be held at the target temperature, even in holding stores.

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

See Generic Standards and/or Generic Guidance Notes.

Appendix 1 Minor pests of fresh Broccoli

Chemical treatment for these pests is only justified if they are present in crops or where there is a history of infestation on the farm.

Beet cyst nematode(*Heterodera schachtii*)

Found mainly in East Anglia and the Isle of Axholme, It attacks most members of the beet and Broccoli families. Although Broccoli are rarely damaged they are effective hosts on which the nematode can increase to a level that will affect future beet crops.

Sample if its presence is suspected and avoid frequent cropping with alternative host crops if the nematode is present.

Brassica cyst nematode(*Heterodera cruciferae*)

This pest is widely distributed; it rarely reduces crop yield. Cysts survive in the soil for several years until stimulated to hatch by the presence of a fresh host crop.

Sample if its presence is suspected and avoid overcropping with brassica crops. Routine treatment is rarely justified.

Cabbage leaf miners(*Phytomyza rufipes* and *Scaptomyza aplicalis*)

Both species are widely distributed, occasionally damaging Cabbage. *As large populations can develop in oilseed rape crops, avoid siting Cabbage nearby if possible.* Control measures are only required if damage levels are high; sprays applied for diamond back moth will keep leaf miner under control.

Cabbage seed weevil

In recent years large numbers of adult cabbage seed weevils have arrived on brassica crops in some localities in mid-summer. Weevils can damage the mature crop by feeding on the spear or outer leaves and contaminate the Broccoli spear prior to harvest. They have occasionally checked the growth of newly planted crops.

Vulnerable crops, particularly those on the point of harvest, should be examined frequently from mid-July to mid-August. Applications of a synthetic pyrethroid for control of caterpillars should kill some weevils and deter others from entering the crop.

Cabbage stem flea beetle(*Psylliodes chrysocephala*)

A widespread and locally serious pest attacking most overwintering brassica crops especially seed crops. The build up of this pest on oilseed rape may lead to more serious attacks on vegetable brassicas. Even comparatively light attacks can reduce the size of heads.

Site overwintering vegetable brassica crops as far as possible from oilseed rape or other seed crops which can harbour large number of the pest. Pyrethroids, applied as soon as serious adult feeding is seen, or when larval damage is noted, will give some control.

Cabbage whitefly(*Aleyrodes proletella*)

An occasional pest and damage is caused by the adults and white scale-like larvae living on the undersides of the leaves and sucking the sap. Where large numbers present plant vigour may be reduced.

Up to five generations a year may occur as adults over-winter on the undersides of the leaves. Severe infestations produce a

sticky secretion that attracts a black-sooty mould.

Destroy overwintering brassica crops soon after harvest to prevent the movement of whitefly to the new season's crops. Treatment is rarely necessary, but pyrethroids will provide some control given good coverage.

Flea beetles(*Phyllotreta spp.*)

In direct drilled crops, small holes are eaten in cotyledons, stems and first and second rough leaves. In warm dry conditions, the damage can be severe and seedlings may be killed.

Damage to young plants is fairly rare and most crops establishing quickly grow away satisfactorily without further treatment.

If damage is severe, or seedlings are growing slowly, use deltamethrin for control.

Leatherjackets(*Tipula spp.*)

Leather jackets are only likely to be of importance in fields previously in grass, or weedy stubble. Most damage occurs in the spring.

Plough grassland before early August to prevent egg laying. If early ploughing is not possible, seek advice on potential risk.

Turnip gall weevil(*Ceutorhynchus pleurostigma*)

A localised and sporadic pest frequently found in southwest England. It attacks late-sown or late-planted Broccoli, the legless grubs feed on the roots within hollow marble-sized galls. Yields are rarely affected.

Good soil and growing conditions help plants withstand attack.

Wireworms(*Agriotes spp*)

Wireworms are only likely to be of consequence in fields cropped soon after long term grass.

Plough early with additional cultivations if wireworm damage is anticipated. Seek advice on degree of risk if in doubt.

Swede midge(*Contarinia nasturii*)

Midge occasionally causes severe localised damage in the growing points of young plants, resulting in premature death of the plant or blindness that may be followed by a stem rot. The first generation of larvae appears during the second half of May/beginning of June. There are two or three generations in a season and one of the later ones may attack side shoots. High humidity situations favour their build-up, whereas drought slows or stops emergence. The larvae hatch from eggs laid in groups of 15-25 and feed on the young tissue in the growing points. Attacks are rare in the UK.

At present no chemical has approval for the control of swede midge, however, midge larvae control has been observed when pyrethroids have been used for caterpillar control.

Appendix 2 Fertiliser requirements for Broccoli (kg/ha)

Based on DEFRA fertiliser recommendations (RB 209)

Nutrient (kg/ha)	Soil Index						
	0	1	2	3	4	5	6
Nitrogen	290	250	210	175	120	40	0
Phosphorus	200	150	100	50M	0	0	0
Potassium	275	225	(2-) 175 (2+) 125M	35	0	0	0
Magnesium (all soils)	150	100	nil	0	0	0	0

Notes:

The magnesium/potassium ratio should not exceed 1:4; otherwise compensatory magnesium will need to be applied. For vegetable crops, soils should be maintained at Index 3 for phosphorous, and Index 2 for potassium. At these indices maintenance amounts of fertiliser are needed (M).

Well-composted farmyard manure at about 25 t/ha will provide adequate phosphate and potash at Index 3, without the need for additional fertiliser. All manures should be well incorporated to avoid microbial contact with the crop. At lower indices, the recommended fertiliser rates shown in the table above should be reduced for each 10 t/ha farmyard manure applied by 15 kg/ha phosphorous and 40 kg/ha potassium.

Appendix 3 Soil Nitrogen Supply (SNS) Indices based previous cropping and rainfall

Detailed SNS tables based on previous cropping and average annual rainfall can be found in DEFRA publication 'Fertiliser Recommendations for Agricultural and Horticultural Crops – 7th Edition (RB209) published by the Stationary Office (ISBN 0 11 243058 9) telephone orders 0870 600 5522. Tables can also be downloaded free of charge from www.defra.gov.uk/farm/environment/land-manage/nutrient/fert/rb209/intro.pdf

Appendix 4 Insecticides currently approved for cabbage root fly control on leaf, head and flowerhead brassicas

Active Ingredient	Product Features	Crop Approval Type				Harvest Interval	LERAP Category	Hazard Rating	UK MRL (mg/kg)				
		Broccoli	Brussels Sprouts	Cabbage	Cauliflower				Kale & Collards	Broc	B Spr	Cabb	Cauli
carbosulfan	Granule formulation. Systemic carbamate insecticide. Will also control flea beetles and early aphid infestations.	Full Approval - Note all approvals expire 13 December 2008				84-161 days (see label)	None stated	Harmful	0.05 LOD	0.05 LOD	0.05 LOD	0.05 LOD	0.05 LOD
chlorpyrifos ⁽¹⁾	available as granule and emulsifiable concentrate formulation. Contact and ingested organo-phosphate. Broad spectrum. Only EC/WG formulations approved for use on Kale/Collards and Sprouts.	Full	Full EC & WG formulations. Module and plant drench only.	Full	SOLA's Various see App. 12.	Granule: 42 days EC/WG: 21 days	A	Harmful Irritant	0.05 LOD	0.05 LOD	1.0	0.05 LOD	0.05 LOD
spinosad	a selective insecticide derived from naturally occurring soil fungi. Applied as a module or in-field drench. All MRLs UK Temporary MRLs	SOLA 2086/06	SOLA 0319/06	SOLA 0319/06	No Approval	Preplant or within 3 days of planting	B	None	0.01 UK Temp MRL	0.05	0.2 UK Temp MRL	0.05 UK Temp MRL	10 Codex

Notes:

MRL Key : Broc - Broccoli, B Spr - Brussels Sprouts, Cabb - Head Cabbage, Coll - Collards

LOD - MRL set at or about the Limit of Determination

⁽¹⁾ **SOLA** - See Appendix 12 for specific product name and expiry date.

Not all products containing these active ingredients may be currently approved for use on leaf and flowerhead brassicas. As label recommendations are revised regularly, always read a current label prior to use.

MRL's have been included where a level has been set in the Maximum Residue in Crops, Food and Feeding Stuffs Regulations, 1995.

Appendix 5 Insecticides currently approved for aphid control in leaf, head and flowerhead brassicas

Foliar sprays

Active Ingredient	Product Features	Crop Approval Type				Harvest Interval			I.E.R.A.P. Category	Hazard Rating	UK MRL (mg/kg)			
		Broccoli	Brussels Sprouts	Cabbage	Cauliflower	Collards	Days	Broc			B Spr	Cabb	Cauli	Coll
acetamiprid	neo-nicotinoid systemic insecticide	No Approval	SOLA 2866/07	No approval			21 days	B	None	0.01 LOD	0.05 UK Temp MRL	0.01 LOD	0.01 LOD	0.01 LOD
alpha cypermethrin ⁽¹⁾	contact and ingested pyrethroid insecticide	Full	Full	Full	Full	SOLA 2265/05	7 days	A	Harmful Irritant	0.5				1.0
bifenthrin	contact and residual pyrethroid insecticide for control of aphid and whitefly.	Full	Full	Full	Full	No Approval	2 days	A	Harmful Irritant	0.2	1.0	1.0	0.2	0.05 LOD
chlorpyrifos	contact organo-phosphate, broad spectrum.	Full	No Approval	Full	Full	No Approval	21 days	A	Harmful Irritant	0.05 LOD	0.05 LOD	1.0	0.05 LOD	0.05 LOD
cypermethrin	contact and ingested pyrethroid insecticide.	Full	Full	Full	Full	SOLA 1772/07 expires 31/8/08	Zero	A	Harmful Irritant	0.5	0.5	0.5	0.5	1.0
deltamethrin	contact and ingested pyrethroid insecticide.	Full	Full	Full	Full	Various SOLAs see App. 12	Zero	A	Harmful Irritant	0.1				0.5

Notes:

MRL Key : Broc - Broccoli, B Spr - Brussels Sprouts, Cabb - Head Cabbage, Coll - Collards

LOD - MRL set at or about the Limit of Determination.

⁽¹⁾ **SOLA** - See Appendix 12 for specific product name and expiry date.

Not all products containing these active ingredients may be currently approved for use on leaf and flowerhead brassicas. As label recommendations are revised regularly, always read a current label prior to use.. MRL's have been included where a level has been set in the Maximum Residue in Crops, Food and Feeding Stuffs Regulations, 1995.

Appendix 5 Insecticides currently approved for aphid control in leaf, head and flowerhead brassicas (Cont'd)

Foliar sprays (Cont'd)

Active Ingredient	Product Features	Crop Approval Type				Collards	Harvest Interval	LERAP Category	Hazard Rating	UK MRL (mg/kg)				
		Broccoli	Brussels Sprouts	Cabbage	Cauliflower					B Spr	Cabb	Cauli	Coll	
dimethoate ⁽¹⁾	systemic organo-phosphate. Broad spectrum. Dangerous to a wide range of beneficial insects.	Full	Full	SOLA 0808/06	Full	SOLA 0808/06	Full approval 21 days	A	Harmful Irritant	0.02 LOD	0.3	1.0	0.2	0.02 LOD
lambda cyhalothrin	contact and ingested pyrethroid insecticide. Broad spectrum.	Full	Full	Full	Full	No Approval	Zero	A	Harmful Irritant	0.1	0.05	0.2	0.1	1.0
lambda cyhalothrin* + pirimicarb	useful combination of pyrethroid and carbamate insecticides where both caterpillars and aphids are a problem.	Full	Full	Full	Full	No Approval	3 days	A	Harmful	0.1*	0.05*	0.2*	0.1*	1.0*

Notes:

MRL Key : Broc - Broccoli, B Spr - Brussels Sprouts, Cabb - Head Cabbage, Coll - Collards

LOD - MRL set at or about the Limit of Determination.

⁽¹⁾ **SOLA** - See Appendix 12 for specific product name and expiry date.

⁽²⁾ True Leaf.

Not all products containing these active ingredients may be currently approved for use on leaf and flowerhead brassicas. As label recommendations are revised regularly, always read a current label prior to use.

MRL's have been included where a level has been set in the Maximum Residue in Crops, Food and Feeding Stuffs Regulations, 1995.

Appendix 5 Insecticides currently approved for aphid control in leaf, head and flowerhead brassicas (Cont'd)

Foliar sprays (Cont'd)

Active Ingredient	Product Features	Crop Approval Type				Harvest Interval	LERAP Category	Hazard Rating	UK MRL (mg/kg)					
		Broccoli	Brussels Sprouts	Cabbage	Cauliflower				Collards	Broc	B Spr	Cabb	Cauli	Coll
nicotine	general purpose, non-persistent, contact, alkaloid insecticide.	Full	Full	Full	Full	SOLAs 3288/06 3278/06	2 days	Toxic	None set	None set	None set	None set	None set	None set
pirimicarb	contact, fumigant and translaminar insecticide. Little effect on bees or beneficial insects. <i>Myzus persicae</i> resistance reported in some areas.	Full	Full	Full	Full	Full	3 days	Harmful	No UK MRL CODEX 1.0	No UK MRL CODEX 1.0	No UK MRL CODEX 1.0	No UK MRL CODEX 1.0	No UK MRL CODEX 1.0	None set
pymetrozine (1)	novel azomethine systemic aphicide which prevents aphid feeding. Controls OP and carbamate resistant <i>Myzus persicae</i> .	Full & SOLA 4031/06	Full & SOLA 4031/06 (SOLA expires 28/02/07)	SOLA 0385/05	SOLA 0385/05	SOLA 4031/06	Full & SOLA 4031/06 14 days	None stated	0.02 LOD	0.02 LOD	0.02 LOD	0.02 LOD	0.02 LOD	0.02
thiacloprid	aneo-nicotinoid insecticide controls MACE resistant <i>Myzus persicae</i>	SOLA 3815/06	No Approval	No Approval	No Approval	No Approval	7 days	Harmful	None set	None set	None set	None set	None set	None set

Notes:

MRL Key : Broc - Broccoli, B Spr - Brussels Sprouts, Cabb - Head Cabbage, Kale - Kale/Collards

LOD - MRL set at or about the Limit of Determination

(1) **SOLA** - See Appendix 12 for specific product name and expiry date.

Not all products containing these active ingredients may be currently approved for use on leaf and flowerhead brassicas. As label recommendations are revised regularly, always read a current label prior to use.

MRL's have been included where a level has been set in the Maximum Residue in Crops, Food and Feeding Stuffs Regulations, 1995.

Appendix 6 Insecticides currently approved for caterpillar control in leaf, head and flowerhead brassicas

Active Ingredient	Product Features	Crop Approval Type				Harvest Interval	LERAP Category	Hazard Rating	UK MRL (mg/kg)				
		Broccoli	Brussels Sprouts	Cabbage	Cauliflower				Collards	Broc	B Spr	Cabb	Cauli
alpha cypermethrin ⁽¹⁾	contact and ingested pyrethroid insecticide.	Full	Full	Full	Full	7 days	A	Harmful Irritant		0.5			1.0
<i>Bacillus thuringiensis</i>	bacterial insecticide affecting the gut lining of the larvae and therefore must be eaten to be effective	Full	Full	Full	Full	SOLA 2265/05	None stated	None stated		None set			
bifenthrin	contact and residual pyrethroid insecticide for control of aphid and whitefly	Full	Full	Full	Full	SOLA 0739/04	A	Harmful Irritant	0.2	1.0	1.0	0.2	0.05 LOD
chlorpyrifos	contact organo-phosphate, broad spectrum	Full	No Approval	Full	Full	No approval	A	Harmful Irritant	0.05 LOD	0.05 LOD	1.0	0.05 LOD	0.05 LOD
cypermethrin	a contact and stomach acting pyrethroid insecticide	Full	Full	Full	Full	SOLA 1772/07	A	Harmful Irritant		0.5			1.0
deltamethrin	a pyrethroid insecticide with contact and residual activity.	Full	Full	Full	Full	Various SOLAs see App 12	A	Harmful Irritant Flammable		0.1			0.5

Notes:

MRL Key : Broc - Broccoli, B Spr - Brussels Sprouts, Cabb - Head Cabbage, Kale - Kale/Collards

LOD - MRL set at or about the Limit of Determination

⁽¹⁾ **SOLA** - See Appendix 12 for specific product name and expiry date.

Not all products containing these active ingredients may be currently approved for use on leaf and flowerhead brassicas. As label recommendations are revised regularly, always read a current label prior to use.

MRL's have been included where a level has been set in the Maximum Residue in Crops, Food and Feeding Stuffs Regulations, 1995.

Appendix 6 Insecticides currently approved for caterpillar control in leaf, head and flowerhead brassicas (Cont'd)

Active Ingredient	Product Features	Crop Approval Type				Harvest Interval	LERAP Category	Hazard Rating	UK MRL (mg/kg)					
		Broccoli	Brussels Sprouts	Cabbage	Cauliflower				Collards	Broc	B Spr	Cabb	Cauli	Coll
diflubenzuron	selective, persistent, contact and stomach acting substituted urea. Acts by disrupting chitin synthesis and prevents egg hatch.	Full	Full	Full	Full	No Approval	14 days	None stated	None set					
indoxacarb	Ingested and contact oxadiazine insecticide	Full	No Approval	Full	Full	No Approval	1 day	None stated	0.3	0.02 LOD	3.0	0.3	0.2	
lambda cyhalothrin	contact and ingested pyrethroid insecticide. Broad spectrum.	Full	Full	Full	Full	No Approval	Zero	Harmful Irritant	0.1	0.05	0.2	0.1	1.0	
lambda cyhalothrin* + pirimicarb**	useful combination of pyrethroid and carbamate insecticides where both caterpillars and aphids are a problem.	Full	Full	Full	Full	No Approval	3 days	Harmful	0.1*	0.05*	0.2*	0.1*	1.0*	
nicotine	general purpose, non-persistent, contact, alkaloid insecticide.	Full	Full	Full	Full	SOLAs 3288/06 3278/06	2 days	Toxic	None set					
spinosad	a selective insecticide derived from naturally occurring soil fungi.	SOLA 0849/07	Full	Full	Full	No Approval	3 days	None stated	0.01 UK Temp MRL	0.05 UK Temp MRL	0.2 UK Temp MRL	0.05 UK Temp MRL	10 CODEX	

Notes:

MRL Key : Broc - Broccoli, B Spr - Brussels Sprouts, Cabb - Head Cabbage, Kale - Kale/Collards

⁽¹⁾ SOLA - See Appendix 12 for specific product name and expiry date.

LOD - MRL set at or about the Limit of Determination.

Not all products containing these active ingredients may be currently approved for use on leaf and flowerhead brassicas. As label recommendations are revised regularly, always read a current label prior to use.

MRL's have been included where a level has been set in the Maximum Residue in Crops, Food and Feeding Stuff's Regulations, 1995.

Appendix 7 Fungicides currently approved for use on leaf, head and flowerhead brassicas**a) Propagation****Notes:**

MRL Key : Broc - Broccoli, B Spr - Brussels Sprouts, Cabb - Head Cabbage, Coll - Collards

⁽¹⁾ **SOLA** - See Appendix 12 for specific product name and expiry date.

LOD - MRL set at or about the Limit of Determination.

Not all products containing these active ingredients may be currently approved for use on leaf and flowerhead brassicas. As label recommendations are revised regularly, always read a current label prior to use.

MRL's have been included where a level has been set in the Maximum Residue in Crops, Food and Feeding Stuffs Regulations, 1995.

Appendix 7 Fungicides currently approved for use on leaf, head and flowerhead brassicas (Cont'd)

b. Field application

Active Ingredient	Product Features	Crop Approval Type				Harvest Interval	LERAP Category	Hazard Rating	UK MRL (mg/kg)				
		Broccoli	Brussels Sprouts	Cabbage	Cauliflower				Collards	Broc	B Spr	Cabb	Cauli
azoxystrobin ⁽¹⁾	target : Xanthomonas; systemic translaminar and protectant strobilurin	Full	Full	Full	Full	14 days	None stated	None	0.5	0.3	0.3	0.5	5
azoxystrobin* + difenoconazole	target : ringspot, Alternaria. Mixture of eradicant triazole and protectant strobilurin fungicide	Full	Full	Full	Full	21 days	None stated	Irritant	0.5*	0.3*	0.3*	0.5*	5*
boscalid* + pyraclostrobin** ⁽¹⁾	target : ringspot, <i>Alternaria</i> and white blister. Anilide and strobilurin fungicide mixture.	No approval	Full	Full	Full	14 days	B	Harmful	1.0* UK Temp MRL	1.0* UK Temp MRL	1.0* UK Temp MRL	1.0* UK TEMP MRL	10.0* UK Temp MRL
chlorothalonil	target : <i>Alternaria</i> sp., <i>Botrytis</i> sp., downy mildew, damping off and wirestem. Protectant chlorophenyl.	Full	Full	Full	Full	7 days	B	Irritant	3.0	3.0	3.0	3.0	0.01 LOD
chlorothalonil* + metalaxyl-M†	target : white blister & downy mildew. Protectant chlorophenyl and systemic phenylamide.	Full	Full	No Approval	Full	14 days	B	Harmful Irritant	3.0* 0.2†	3.0* LOD	3.0* 1.0†	3.0* 0.2†	0.01* LOD 0.2†

Notes:

MRL Key : Broc - Broccoli, B Spr - Brussels Sprouts, Cabb - Head Cabbage, Coll - Collards

⁽¹⁾ **SOLA** - See Appendix 12 for specific product name and expiry date.

LOD - MRL set at or about the Limit of Determination.

Not all products containing these active ingredients may be currently approved for use on leaf and flowerhead brassicas. As label recommendations are revised regularly, always read a current label prior to use. MRL's have been included where a level has been set in the Maximum Residue in Crops, Food and Feeding Stuffs Regulations, 1995.

Appendix 7 Fungicides currently approved for use on leaf, head and flowerhead brassicas (Cont'd)

b. Field application (Cont'd)

Active Ingredient	Product Features	Crop Approval Type				Harvest Interval	LERAP Category	Hazard Rating	UK MRL (mg/kg)				
		Broccoli	Brussels Sprouts	Cabbage	Cauliflower				Collards	Broc	B Spr	Cabb	Cauli
copper oxychloride ⁽¹⁾	bactericide: for control of spear rot and <i>Xanthomonas</i>	SOLA's Various see App.12.				3 days	None stated	None stated	None set				
difenoconazole	target : <i>Alternaria</i> sp & ringspot. Diphenyl-ethertriazole protectant and curative fungicide.	Full	Full	Full	SOLAs 1490/05 0558/05	Full -21 days SOLAs 14 days	None stated	Irritant	None set				
flusilazole ⁽¹⁾	target: phoma and light leaf spot. Systemic conazole	No approval	SOLA 3998/06	No approval	No approval	35 days	None stated	Toxic	None set				
Iprodione	target : <i>Alternaria</i> sp. Protectant dicarboximide fungicide with some eradicant activity. Proposed EU MRL of 0.1 mg/kg from 24/02/07 (broccoli and cauliflower)	Full	Full	No Approval	No approval	21 days	None stated	Harmful	0.1	0.5	5.0	0.1	0.02 LOD
mancozeb* + metalaxyl-mf ⁽¹⁾	target : white blister. Systemic and protectant fungicide mix.	No Approval	No Approval	SOLA 1610/01	No Approval	14 days	None stated	Irritant	1.0*	1.0*	1.0*	1.0*	2.0*
tebuconazole ⁽¹⁾	target : <i>Alternaria</i> sp, ring spot, light leaf spot and powdery mildew. Systemic conazole.	SOLAs Various see App. 12.	Full	Full	SOLAs Various see App.12.	21 days	None stated	Harmful Irritant	0.1 UK Temp MRL	0.3 UK Temp MRL	0.8 UK Temp MRL	0.1 UK Temp MRL	None set
tebuconazole* + trifloxystrobin**	target: <i>Alternaria</i> sp. ring spot, light leaf spot and powdery mildew. Systemic conazole + protectant strobilurin	Full	Full	Full	No Approval	21 days	None stated	Harmful Irritant	0.1* UK Temp MRL	0.3* UK Temp MRL	0.8* UK Temp MRL	0.1* UK Temp MRL	0.02 LOD**

Notes: MRL Key : Broc - Broccoli, B Spr - Brussels Sprouts, Cabb - Head Cabbage, Coll - Collards
LOD - MRL set at or about the Limit of Determination

⁽¹⁾ SOLA - See Appendix 12 for specific product name and expiry date.

Not all products containing these active ingredients may be currently approved for use on leaf and flowerhead brassicas. As label recommendations are revised regularly, always read a current label prior to use.

MRL's have been included where a level has been set in the Maximum Residue in Crops, Food and Feeding Stuffs Regulations, 1995.

Appendix 7 Fungicides currently approved for use on leaf, head and flower head brassicas (Cont'd)

c) Fungicide drench treatments for storage cabbage.

Active Ingredient	Product Features	Crop Approval Type				Harvest Interval	LERAP Category	Hazard Rating	UK MRL (mg/kg)			
		Broccoli	Brussels Sprouts	Cabbage	Cauliflower				Collards	B Spr	Cabb	Cauli
iprodione	target : <i>Botrytis cinerea</i> in storage cabbage.	No Approval	No Approval	Full (expires 31/12/08)	No Approval	56 days	None stated	Irritant	0.1	5.0	0.1	0.02 LOD
metalaxyl-m ⁽¹⁾	target : <i>Phytophthora</i> in storage cabbage.	No Approval	No Approval	SOLA 2117/06	No Approval	7 weeks before sale or processing	None stated	None stated	0.2	1.0	0.2	0.2

Notes:

MRL Key : Broc - Broccoli, B Spr - Brussels Sprouts, Cabb - Head Cabbage, Coll - Collards

LOD : MRL set at or about the Limit of Determination

⁽¹⁾ **SOLA** - See Appendix 12 for specific product name and expiry date.

Not all products containing these active ingredients may be currently approved for use on leaf and flowerhead brassicas. As label recommendations are revised regularly, always read a current label prior to use.

MRL's have been included where a level has been set in the Maximum Residue in Crops, Food and Feeding Stuffs Regulations, 1995.

Appendix 8 Seed treatments for use on leaf, head and flowerhead brassicas

The following seed treatments have been approved and are available either individually or in a mixture as an optional service from UK seedhouses.

Active Ingredient	Product Features	Crop Approval Type				Harvest Interval	LERAP Category	Hazard Rating	UK MRL (mg/kg)					
		Broccoli	Brussels Sprouts	Cabbage	Cauliflower				Collards	Broc	B Spr	Cabb	Cauli	Coll
chlorpyrifos	target : cabbage root fly. Contact insecticide.	No approval for UK application but treated seed may be imported and used until 31/12/07				NA	None stated	Harmful	0.05 LOD	0.05 LOD	1.0	0.05 LOD	0.05 LOD	None stated
imidacloprid (1)	target : early aphid control (Myzus persicae). Systemic insecticide.	SOLA 3927/02	SOLA 3927/02	SOLA 3927/02	SOLA 3927/02	NA	None stated	Irritant	0.5 CODEX				None stated	
iprodione	target : seed borne Alternaria sp.	Full	No approval	Full	Full	NA	None stated	Irritant	0.1	0.5	5.0	0.1	0.02 LOD	
thiram	target : seedling damping off diseases	No Approval	Approval	Full	Full	NA	None stated	Irritant	None set					

Notes:

MRL Key : Broc - Broccoli, B Spr - Brussels Sprouts, Cabb - Head Cabbage, Coll - Collards

LOD : MRL set at or about the Limit of Determination

(1) **SOLA** - See Appendix 12 for specific product name and expiry date.

Not all products containing these active ingredients may be currently approved for use on leaf and flowerhead brassicas. As label recommendations are revised regularly, always read a current label prior to use.

MRL's have been included where a level has been set in the Maximum Residue in Crops, Food and Feeding Stuffs Regulations, 1995.

Appendix 9 Herbicides currently approved for use on leaf, head and flowerhead brassicas

Active Ingredient	Product Features	Crop Approval Type					Harvest Interval	LERAP Category	Hazard Rating	UK MRL (mg/kg)			
		Broccoli	Brussels Sprouts	Cabbage	Cauliflower	Collards				Broc	B Spr	Cabb	Cauli
chlorthal-dimethyl	target : residual benzoic. Apply after drilling, before crop emergence or after planting. Do not plant lettuce within 6 months other crops within 3 months.	Full	Full	Full	Full	SOLA 1552/06	Not restricted	None stated	None set				
chlorthal-dimethyl + propachlor	target : residual benzoic and chloroacetamide herbicide mix.	Full	Full	Full	Full	Kale - Full Collards - SOLA 1247/06	Not restricted	Irritant	None set				
clomazone	target: residual herbicide	SOLA 1031/04	SOLA 1031/04	SOLA 1031/04	SOLA 1031/04	SOLA 1031/04	Not restricted	Irritant	None set				
clopyralid	target : control of <i>Compositae</i> weeds. Foliar, translocated piclonic.	Full	Full	Full	Full	Various SOLAs see App 12	42 days	None stated	None set				
cycloxydim	target : annual grasses, blackgrass and couch. Translocated post-emergence oxime herbicide. No control of annual meadow grass.	No Approval	Full	Full	Full	No Approval	28-56 days. Check product label	Irritant	2 CODEX				none stated

Notes:

MRL Key : Broc - Broccoli, B Spr - Brussels Sprouts, Cabb - Head Cabbage, Coll - Collards

LOD : MRL set at or about the Limit of Determination

(1) **SOLA** - See Appendix 12 for specific product name and expiry date.

Not all products containing these active ingredients may be currently approved for use on leaf and flowerhead brassicas. As label recommendations are revised regularly, always read a current label prior to use.

MRL's have been included where a level has been set in the Maximum Residue in Crops, Food and Feeding Stuffs Regulations, 1995.

Appendix 9 Herbicides currently approved for use on leaf, head and flowerhead brassicas (Cont'd)

Active Ingredient	Product Features	Crop Approval Type				Harvest Interval	LERAP Category	Hazard Rating	UK MRL (mg/kg)					
		Broccoli	Brussels Sprouts	Cabbage	Cauliflower				Collards	Broc	B Spr	Cabb	Cauli	Coll
fluzifop-p-butyl (1)	target : volunteer cereals and couch (no control of annual meadow grass). Phenoxypropionic acid graminicide.	No Approval	No Approval	No Approval	No Approval	SOLA's 2231/04 2138/03	56 days	None stated	Irritant	None set				
metazachlor	target : residual anilide herbicide for broad leaved weed control.	Full	Full	Full	Full	SOLA Various See App.12.	42 days SOLAs 10 days after transplanting or 8TL drilling	None stated	Harmful	None set				
pendimethalin	target : residual dinitroaniline. Approval for pre-planting application only.	Full	Full	Full	Full	No approval	Pre-planting	None stated	None stated	0.05 LOD				
propachlor	target : residual chloroacetamide for control of annual dicotyledons and annual grasses.	Full	Full	Full	Full	Various SOLAs see App 12	Young plant	None stated	Harmful Irritant	None set				

Notes:

MRL Key : Broc - Broccoli, B Spr - Brussels Sprouts, Cabb - Head Cabbage, Coll - Collards

LOD : MRL set at or about the Limit of Determination

(1) **SOLA** - See Appendix 12 for specific product name and expiry date.

Not all products containing these active ingredients may be currently approved for use on leaf and flowerhead brassicas. As label recommendations are revised regularly, always read a current label prior to use.

MRL's have been included where a level has been set in the Maximum Residue in Crops, Food and Feeding Stuffs Regulations, 1995.

Appendix 9 Herbicides currently approved for use on leaf, head and flowerhead brassicas (Cont'd)

Active Ingredient	Product Features	Crop Approval Type				Harvest Interval	LERAP Category	Hazard Rating	UK MRL (mg/kg)				
		Broccoli	Brussels Sprouts	Cabbage	Cauliflower				Collards	Broc	B Spr	Cabb	Cauli
Trifluralin	target : annual dicotyledons & grasses. Soil incorporated dinitroaniline. Long residual action.	Full	All approvals expire 20 March 2009			Pre-planting	None stated	Irritant Flammable	None set				
tepraloxydim	A systemic post emergence herbicide	No approval	No approval	Full Approval	No approval	Before head/curd forms	None stated	Irritant	None set	None set	1.0 UK Temp MRL	0.5 UK Temp MRL	None set

Notes:

MRL Key : Broc - Broccoli, B Spr - Brussels Sprouts, Cabb - Head Cabbage, Coll - Collards

LOD : MRL set at or about the Limit of Determination

(1) **SOLA** - See Appendix 12 for specific product name and expiry date.

Not all products containing these active ingredients may be currently approved for use on leaf and flowerhead brassicas. As label recommendations are revised regularly, always read a current label prior to use.

MRL's have been included where a level has been set in the Maximum Residue in Crops, Food and Feeding Stuffs Regulations, 1995.

Appendix 10 Molluscicides currently approved for use on leaf, head and flowerhead brassicas

Active Ingredient	Product Features	Crop Approval Type				Harvest Interval	LERAP Category	Hazard Rating	UK MRL (mg/kg)				
		Broccoli	Brussels Sprouts	Cabbage	Cauliflower				Collards	Broc	B Spr	Cabb	Cauli
copper silicate	target : slugs/snails. Repellent effect.	Full	Full	Full	Full	Full	None stated	None	None set				
ferric phosphate	target : slugs/snails. Low toxicity to non target species.	Full	Full	Full	Full	Full	None stated	None	None set				
metaldelhyde	target : slugs/snails. Use does preserve ground beetle populations.	Full	Full	Full	Full	Full	None stated	None	None set				
methiocarb	target : slugs/snails. Stomach acting carbamate. Reduces population of cutworms and millipedes.	No approval	Full	Full	Full	No approval	14 days	Harmful	None set				
phasmarhabditis hermaphrodita	target : slugs. Parasitic nematode. Best applied in moist conditions.	Full	Full	Full	Full	Full	None	None	None set				
thiodicarb	target : slugs/snails. Stomach acting carbamate.	No approval	Full - all approvals expire 28/11/08 or before	No approval	No approval	No approval	21 days	Harmful Irritant	LOD 0.05				

Notes:

MRL Key : Broc - Broccoli, B Spr - Brussels Sprouts, Cabb - Head Cabbage, Coll - Collards

LOD : MRL set at or about the Limit of Determination

(1) **SOLA** - See Appendix 12 for specific product name and expiry date.

Not all products containing these active ingredients may be currently approved for use on leaf and flowerhead brassicas. As label recommendations are revised regularly, always read a current label prior to use.

MRL's have been included where a level has been set in the Maximum Residue in Crops, Food and Feeding Stuffs Regulations, 1995.

Appendix 11 Off-label approval for Broccoli by extrapolation

The green flower-head brassica referred to as "Broccoli" throughout this protocol is referred to as "Calabrese" in the 2006 U.K. Pesticide Guide, whilst "Broccoli" is used as a generic term to describe various minor forms such as white sprouting, purple sprouting and cape Broccoli.

Broccoli and Calabrese are in the same PSD crop hierarchy therefore both SOLA and full label approvals stating broccoli can be legally used on calabrese and vice versa. PSD define broccoli/calabrese as “varieties of *Brassica oleracea var italica* grown for their immature inflorescences. Includes all forms of purple and green sprouting broccoli and calabrese”.

Appendix 12 Specific off-label approvals for leaf, head and flowerhead brassicas

SOLA	Product	Active Ingredient	Crop Approval	Expiry
2866/07	Insyst	Acetamiprid	brussels sprout (outdoor)	31-Dec-14
2265/05	Contest	Alpha-cypermethrin	collard (outdoor)	31-Dec-13
1761/07	Fastac (10220)	Alpha-cypermethrin	broccoli (outdoor)	31-Aug-08
1761/07	Fastac (10220)	Alpha-cypermethrin	calabrese (outdoor)	31-Aug-08
1761/07	Fastac (10220)	Alpha-cypermethrin	cauliflower (outdoor)	31-Aug-08
0739/04	Dipel DF	Bacillus thuringiensis var. kurstaki	calabrese (outdoor)	31-Dec-13
0739/04	Dipel DF	Bacillus thuringiensis var. kurstaki	collard (outdoor)	31-Dec-13
1595/03	Signum	Boscalid/pyraclostrobin	collard (outdoor)	20-Sept-13
2922/05	Agriguard Chlorothalonil	Chlorothalonil	calabrese (outdoor)(seedling)	28-Feb-11
2940/05	Bravo 500	Chlorothalonil	calabrese (outdoor)	31-Dec-13
2940/05	Bravo 500	Chlorothalonil	calabrese (outdoor)(seedling)	31-Dec-13
2059/07	Bravo 720	Chlorothalonil	calabrese (outdoor)(seedling)	29-Feb-08
0993/07	Cleancrop Rio	Chlorothalonil	calabrese (outdoor)	28-Feb-11
0993/07	Cleancrop Rio	Chlorothalonil	calabrese (outdoor)(seedling)	28-Feb-11
2948/05	Jupital	Chlorothalonil	calabrese (outdoor)	31-Dec-13
2948/05	Jupital	Chlorothalonil	calabrese (outdoor)(seedling)	31-Dec-13
2888/05	Repulse	Chlorothalonil	calabrese (outdoor)	31-Dec-13
2053/07	Sonar	Chlorothalonil	calabrese (outdoor)	31-Dec-13
1909/07	Alpha Chlorpyrifos 48 EC (04821)	Chlorpyrifos	collard (outdoor) (seedling)	31-Aug-08
3667/06	Ballard	Chlorpyrifos	broccoli (outdoor)	31-Dec-13
3687/06	Barclay Clinch II	Chlorpyrifos	broccoli (outdoor)	31-Aug-08
3654/06	CYREN	Chlorpyrifos	broccoli (outdoor)	31-Dec-13
0237/05	CYREN	Chlorpyrifos	collard (outdoor)	31-Dec-13
3655/06	Dursban WG	Chlorpyrifos	broccoli (outdoor)	31-Dec-13
1390/03	Dursban WG	Chlorpyrifos	collard (outdoor)	31-Dec-13
3640/06	Equity	Chlorpyrifos	broccoli (outdoor)	31-Dec-13
0024/08	Govern	Chlorpyrifos	collard (outdoor)	31-Dec-13
0019/08	Govern (12870)	Chlorpyrifos	collard (outdoor)	31-May-08
3656/06	Greencrop Pontoon	Chlorpyrifos	broccoli (outdoor)	31-Aug-08
1587/06	Parapet	Chlorpyrifos	collard (outdoor)	31-Dec-13

Notes:

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Specific off-label uses may only take place if all the conditions of approval, 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 12 Specific off-label approvals for leaf, head and flowerhead brassicas (Cont'd)

SOLA	Product	Active Ingredient	Crop Approval	Expiry
1587/06	Parapet	Chlorpyrifos	collard (outdoor)(seedling)	31-Dec-13
1552/06	Dacthal W75	Chlorthal-dimethyl	collard (outdoor)	31-Dec-13
2148/07	Decimate (11008)	Chlorthal-dimethyl/propachlor	collard (outdoor)	30-Sep-08
1031/04	Centium 360 CS (11607)	Clomazone	broccoli (outdoor)	31-Dec-13
1031/04	Centium 360 CS (11607)	Clomazone	brussels sprouts (outdoor)	31-Dec-13
1031/04	Centium 360 CS (11607)	Clomazone	cabbage (outdoor)	31-Dec-13
1031/04	Centium 360 CS (11607)	Clomazone	calabrese (outdoor)	31-Dec-13
1031/04	Centium 360 CS (11607)	Clomazone	cauliflower (outdoor)	31-Dec-13
1031/04	Centium 360 CS (11607)	Clomazone	collard (outdoor)	31-Dec-13
0659/06	Gamit 36 CS	Clomazone	broccoli (outdoor)	31-Dec-13
0659/06	Gamit 36 CS	Clomazone	brussels sprouts (outdoor)	31-Dec-13
0659/06	Gamit 36 CS	Clomazone	cabbage (outdoor)	31-Dec-13
0659/06	Gamit 36 CS	Clomazone	calabrese (outdoor)	31-Dec-13
0659/06	Gamit 36 CS	Clomazone	cauliflower (outdoor)	31-Dec-13
0659/06	Gamit 36 CS	Clomazone	collard (outdoor)	31-Dec-13
3315/07	Barclay Karaoke	Clopyralid	collard (outdoor)	30-Apr-09
2637/06	Dow Shield	Clopyralid	collard (outdoor)	31-Dec-13
3318/07	Fernpath Torate	Clopyralid	collard (outdoor)	30-Apr-09
1956/06	Glopyr 200 SL	Clopyralid	collard (outdoor)	31-Dec-13
2545/06	Greencrop Champion	Clopyralid	collard (outdoor)	31-Dec-13
3333/07	Loncid	Clopyralid	collard (outdoor)	30-Apr-09
1931/06	Lontrel 200	Clopyralid	collard (outdoor)	31-Dec-13
1930/06	Pilrid	Clopyralid	collard (outdoor)	31-Dec-13
0115/01	Cuprokylt	Copper oxychloride	broccoli (outdoor)	31-Dec-13
0115/01	Cuprokylt	Copper oxychloride	brussels sprout (outdoor)	31-Dec-13
0115/01	Cuprokylt	Copper oxychloride	cabbage (outdoor)	31-Dec-13
0115/01	Cuprokylt	Copper oxychloride	calabrese (outdoor)	31-Dec-13
0115/01	Cuprokylt	Copper oxychloride	cauliflower (outdoor)	31-Dec-13
0115/01	Cuprokylt	Copper oxychloride	collard (outdoor)	31-Dec-13
3499/06	Baythroid (11663)	Cyfluthrin	calabrese (outdoor)	31-Aug-08

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Appendix 12 Specific off-label approvals for leaf, head and flowerhead brassicas (Cont'd)

SOLA	Product	Active Ingredient	Crop Approval	Expiry
1772/07	Permasect C (11121)	Cypermethrin	collard (outdoor)	31-Aug-08
1571/07	Agriuard Deltamethrin	Deltamethrin	collard (outdoor)	01-Nov-08
1577/07	Agrotech Deltamethrin	Deltamethrin	collard (outdoor)	01-Nov-08
1801/07	Cleancrop Decathlon	Deltamethrin	collard (outdoor)	01-Nov-08
2708/05	Delta-M 2.5 EC	Deltamethrin	calabrese (outdoor)	01-Nov-08
2709/05	Delta-M 2.5 EC	Deltamethrin	collard (outdoor)	01-Nov-08
1687/07	Pearl Micro	Deltamethrin	collard (outdoor)	01-Nov-08
1490/05	Difcor 250 EC	Difenoconazole	collard (outdoor)	29-Mar-08
0558/05	Plover	Difenoconazole	collard (outdoor)	31-Dec-13
0389/94	BASF Dimethoate 40	Dimethoate	broccoli (outdoor)	31-Dec-13
0389/94	BASF Dimethoate 40	Dimethoate	calabrese (outdoor)	31-Dec-13
0389/94	BASF Dimethoate 40	Dimethoate	collard (outdoor)	31-Dec-13
0808/06	Danadim	Dimethoate	broccoli (outdoor)(seedling)	31-Dec-13
0808/06	Danadim	Dimethoate	calabrese (outdoor) (seedling)	31-Dec-13
0808/06	Danadim	Dimethoate	collard (outdoor)(seedling)	31-Dec-13
0682/05	Danadim Progress	Dimethoate	calabrese (outdoor) (seedling)	31-Dec-13
0682/05	Danadim Progress	Dimethoate	collard (outdoor)(seedling)	31-Dec-13
2231/04	Fusilade 250 EW	Fluazifop-P-butyl	collard (outdoor)	31-Dec-13
2138/03	Fusilade Max	Fluazifop-P-butyl	collard (outdoor)	31-Dec-13
0102/07	Capitan 25	Flusilazole	brussels sprout (outdoor)	31-Dec-13
0101/07	Genie 25	Flusilazole	brussels sprout (outdoor)	31-Dec-13
3998/06	Lyric	Flusilazole	brussels sprout (outdoor)	31-Dec-13
3988/06	Lyric (08252)	Flusilazole	brussels sprout (outdoor)	29-Feb-08
0100/07	Sanction 25	Flusilazole	brussels sprout (outdoor)	31-Dec-13

Notes:

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Appendix 12 Specific off-label approvals for leaf, head and flowerhead brassicas (Cont'd)

SOLA	Product	Active Ingredient	Crop Approval	Expiry
3524/06	Aliette 80 WG	Fosetyl-aluminium	broccoli (outdoor)	31-Dec-13
3524/06	Aliette 80 WG	Fosetyl-aluminium	broccoli (outdoor)(seedling)	31-Dec-13
3524/06	Aliette 80 WG	Fosetyl-aluminium	brussels sprout (outdoor)	31-Dec-13
3524/06	Aliette 80 WG	Fosetyl-aluminium	brussels sprout (outdoor) (seedling)	31-Dec-13
3524/06	Aliette 80 WG	Fosetyl-aluminium	cabbage (outdoor)	31-Dec-13
3524/06	Aliette 80 WG	Fosetyl-aluminium	cabbage (outdoor)(seedling)	31-Dec-13
3524/06	Aliette 80 WG	Fosetyl-aluminium	calabrese (outdoor)	31-Dec-13
3524/06	Aliette 80 WG	Fosetyl-aluminium	calabrese (outdoor) (seedling)	31-Dec-13
3524/06	Aliette 80 WG	Fosetyl-aluminium	cauliflower (outdoor)	31-Dec-13
3524/06	Aliette 80 WG	Fosetyl-aluminium	cauliflower (outdoor) (seedling)	31-Dec-13
3524/06	Aliette 80 WG	Fosetyl-aluminium	collard (outdoor)	31-Dec-13
3524/06	Aliette 80 WG	Fosetyl-aluminium	collard (outdoor)(seedling)	31-Dec-13
1902/07	Aliette 80 WG (11213)	Fosetyl-aluminium	broccoli (outdoor)(seedling)	31-Aug-08
0149/04	Aliette 80 WG (11213)	Fosetyl-aluminium	broccoli (outdoor)(seedling)	31-Aug-08
0149/04	Aliette 80 WG (11213)	Fosetyl-aluminium	broccoli (outdoor)(seedling)	31-Aug-08
1902/07	Aliette 80 WG (11213)	Fosetyl-aluminium	brussels sprout (outdoor) (seedling)	31-Aug-08
0149/04	Aliette 80 WG (11213)	Fosetyl-aluminium	brussels sprout (outdoor) (seedling)	31-Aug-08
1902/07	Aliette 80 WG (11213)	Fosetyl-aluminium	cabbage (outdoor)(seedling)	31-Aug-08
0149/04	Aliette 80 WG (11213)	Fosetyl-aluminium	cabbage (outdoor)(seedling)	31-Aug-08
1902/07	Aliette 80 WG (11213)	Fosetyl-aluminium	calabrese (outdoor) (seedling)	31-Aug-08
0149/04	Aliette 80 WG (11213)	Fosetyl-aluminium	calabrese (outdoor) (seedling)	31-Aug-08
1902/07	Aliette 80 WG (11213)	Fosetyl-aluminium	cauliflower (outdoor) (seedling)	31-Aug-08
0149/04	Aliette 80 WG (11213)	Fosetyl-aluminium	cauliflower (outdoor) (seedling)	31-Aug-08
0149/04	Aliette 80 WG (11213)	Fosetyl-aluminium	collard (outdoor)(seedling)	31-Aug-08

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Appendix 12 Specific off-label approvals for leaf, head and flowerhead brassicas (Cont'd)

SOLA	Product	Active Ingredient	Crop Approval	Expiry
3570/07	Cleancrop Chicane	Fosetyl-aluminium	broccoli (outdoor)	31-May-09
3570/07	Cleancrop Chicane	Fosetyl-aluminium	broccoli (outdoor)(seedling)	31-May-09
3570/07	Cleancrop Chicane	Fosetyl-aluminium	brussels sprout (outdoor)	31-May-09
3570/07	Cleancrop Chicane	Fosetyl-aluminium	brussels sprout (outdoor) (seedling)	31-May-09
3570/07	Cleancrop Chicane	Fosetyl-aluminium	cabbage (outdoor)	31-May-09
3570/07	Cleancrop Chicane	Fosetyl-aluminium	cabbage (outdoor) (seedling)	31-May-09
3570/07	Cleancrop Chicane	Fosetyl-aluminium	calabrese (outdoor)	31-May-09
3570/07	Cleancrop Chicane	Fosetyl-aluminium	calabrese (outdoor) (seedling)	31-May-09
3570/07	Cleancrop Chicane	Fosetyl-aluminium	cauliflower (outdoor)	31-May-09
3570/07	Cleancrop Chicane	Fosetyl-aluminium	cauliflower (outdoor) (seedling)	31-May-09
3570/07	Cleancrop Chicane	Fosetyl-aluminium	collard (outdoor)	31-May-09
3570/07	Cleancrop Chicane	Fosetyl-aluminium	collard (outdoor)(seedling)	31-May-09
1778/07	Standon Fosetyl-AL 80 AG	Fosetyl-aluminium	broccoli (outdoor)(seedling)	31-Aug-08
1778/07	Standon Fosetyl-AL 80 AG	Fosetyl-aluminium	brussels sprouts (outdoor) (seedling)	31-Aug-08
1778/07	Standon Fosetyl-AL 80 AG	Fosetyl-aluminium	cabbage (outdoor)(seedling)	31-Aug-08
1778/07	Standon Fosetyl-AL 80 AG	Fosetyl-aluminium	calabrese (outdoor) (seedling)	31-Aug-08
1778/07	Standon Fosetyl-AL 80 AG	Fosetyl-aluminium	cauliflower (outdoor) (seedling)	31-Aug-08
1778/07	Standon Fosetyl-AL 80 AG	Fosetyl-aluminium	collard (outdoor)(seedling)	31-Aug-08
3927/02	Gaucho	Imidacloprid	broccoli (outdoor)	31-Dec-13
3927/02	Gaucho	Imidacloprid	brussels sprouts (outdoor)	31-Dec-13
3927/02	Gaucho	Imidacloprid	cabbage (outdoor)	31-Dec-13
3927/02	Gaucho	Imidacloprid	calabrese (outdoor)	31-Dec-13
3927/02	Gaucho	Imidacloprid	cauliflower (outdoor)	31-Dec-13
3927/02	Gaucho	Imidacloprid	collard (outdoor)	31-Dec-13
1610/01	Fubol Gold WG	Mancozeb/metalaxyl-M	cabbage (outdoor)	31-Dec-13
3643/06	Fubol Gold WG	Mancozeb/metalaxyl-M	collard (outdoor)	31-Dec-13

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Appendix 12 Specific off-label approvals for leaf, head and flowerhead brassicas (Cont'd)

SOLA	Product	Active Ingredient	Crop Approval	Expiry
3306/07	Alpha Metazachlor 50 SC	Metazachlor	collard (outdoor)	31-Dec-13
0344/05	Butisan S	Metazachlor	collard (outdoor)	31-Dec-13
3012/06	Devrinol	Napropamide	collard (outdoor)	31-Dec-13
3010/04	Devrinol (09374)	Napropamide	collard (outdoor)	31-Dec-13
3278/06	No-FID	Nicotine	collard (outdoor)	31-Dec-13
3288/06	Stalwart	Nicotine	collard (outdoor)	31-Dec-13
3292/06	XL All Nicotine 95%	Nicotine	calabrese (outdoor)	31-Dec-13
2542/07	Alpha Propachlor 50 SC (04873)	Propachlor	collard (outdoor)	31-Jan-09
3083/06	Brasson	Propachlor	collard (outdoor)	31-Dec-13
3041/06	Ramrod 20 Granular	Propachlor	calabrese (outdoor)	31-Dec-13
3042/06	Ramrod 20 Granular	Propachlor	collard (outdoor)	31-Dec-13
3130/06	Ramrod Flowable	Propachlor	collard (outdoor)	31-Dec-13
3084/06	Sentinel 2	Propachlor	collard (outdoor)	31-Dec-13
3040/06	Tripart Sentinel	Propachlor	calabrese (outdoor)	31-Dec-13
3038/06	Tripart Sentinel	Propachlor	collard (outdoor)	31-Dec-13
0788/07	Chess WG	Pymetrozine	broccoli (outdoor)	31-Oct-11
0788/07	Chess WG	Pymetrozine	broccoli (outdoor)(seedling)	31-Oct-11
0788/07	Chess WG	Pymetrozine	brussels sprout (outdoor)	31-Oct-11
0788/07	Chess WG	Pymetrozine	brussels sprout (outdoor) (seedling)	31-Oct-11
0788/07	Chess WG	Pymetrozine	cabbage (outdoor)	31-Oct-11
0788/07	Chess WG	Pymetrozine	cabbage (outdoor) (seedling)	31-Oct-11
0788/07	Chess WG	Pymetrozine	calabrese (outdoor)	31-Oct-11
0788/07	Chess WG	Pymetrozine	calabrese (outdoor) (seedling)	31-Oct-11
0788/07	Chess WG	Pymetrozine	cauliflower (outdoor)	31-Oct-11
0788/07	Chess WG	Pymetrozine	cauliflower (outdoor) (seedling)	31-Oct-11
0788/07	Chess WG	Pymetrozine	collard (outdoor)	31-Oct-11
0788/07	Chess WG	Pymetrozine	collard (outdoor)(seedling)	31-Oct-11
0788/07	Chess WG	Pymetrozine	collard (outdoor)(spring greens)	31-Oct-11

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Appendix 12 Specific off-label approvals for leaf, head and flowerhead brassicas (Cont'd)

SOLA	Product	Active Ingredient	Crop Approval	Expiry
0789/07	Chess WG (10651)	Pymetrozine	broccoli (outdoor)	31-Jul-08
0789/07	Chess WG (10651)	Pymetrozine	broccoli (outdoor) (seedling)	31-Jul-08
0789/07	Chess WG (10651)	Pymetrozine	brussels sprout (outdoor)	31-Jul-08
0789/07	Chess WG (10651)	Pymetrozine	broccoli (outdoor) (seedling)	31-Jul-08
0789/07	Chess WG (10651)	Pymetrozine	cabbage (outdoor)	31-Jul-08
0789/07	Chess WG (10651)	Pymetrozine	cabbage (outdoor) (seedling)	31-Jul-08
0789/07	Chess WG (10651)	Pymetrozine	calabrese (outdoor)	31-Jul-08
0789/07	Chess WG (10651)	Pymetrozine	calabrese (outdoor) (seedling)	31-Jul-08
0789/07	Chess WG (10651)	Pymetrozine	cauliflower (outdoor)	31-Jul-08
0789/07	Chess WG (10651)	Pymetrozine	cauliflower (outdoor) (seedling)	31-Jul-08
0789/07	Chess WG (10651)	Pymetrozine	collard (outdoor)	31-Jul-08
0789/07	Chess WG (10651)	Pymetrozine	collard (outdoor)(seedling)	31-Jul-08
0789/07	Chess WG (10651)	Pymetrozine	collard (outdoor)(spring greens)	31-Jul-08
2279/07	Plenum WG	Pymetrozine	collard (outdoor)	31-Oct-11
0385/05	Plenum WG	Pymetrozine	collard (outdoor)	31-Oct-11
2086/06	Tracer	Spinosad	broccoli (outdoor)	30-Apr-13
0849/07	Tracer	Spinosad	broccoli (outdoor)	30-Apr-13
0286/06	Tracer	Spinosad	broccoli (outdoor)(seedling)	30-Apr-13
0319/06	Tracer	Spinosad	brussels sprout	30-Apr-13
0319/06	Tracer	Spinosad	cabbage (outdoor)	30-Apr-13
2086/06	Tracer	Spinosad	calabrese (outdoor)	30-Apr-13
0849/07	Tracer	Spinosad	calabrese (outdoor)	30-Apr-13
2086/06	Tracer	Spinosad	calabrese (outdoor) (seedling)	30-Apr-13
0319/06	Tracer	Spinosad	cauliflower (outdoor)	30-Apr-13
1375/07	Alpha Tebuconazole 20 EW	Tebuconazole	broccoli (outdoor)	31-Dec-13
1375/07	Alpha Tebuconazole 20 EW	Tebuconazole	calabrese (outdoor)	31-Dec-13
1375/07	Alpha Tebuconazole 20 EW	Tebuconazole	cauliflower (outdoor)	31-Dec-13
1381/07	Alpha Tebuconazole 20 EW	Tebuconazole	collard (outdoor)	31-Dec-13
1381/07	Alpha Tebuconazole 20 EW	Tebuconazole	collard (outdoor)(spring greens)	31-Dec-13
1874/03	Folicur	Tebuconazole	broccoli (outdoor)	31-Dec-13
1874/03	Folicur	Tebuconazole	calabrese (outdoor)	31-Dec-13

Notes:

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

Specific off-label uses may only take place if all the conditions of approval, 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 12 Specific off-label approvals for leaf, head and flowerhead brassicas (Cont'd)

SOLA	Product	Active Ingredient	Crop Approval	Expiry
1874/03	Folicur	Tebuconazole	cauliflower (outdoor)	31-Dec-13
1872/03	Folicur	Tebuconazole	collard (outdoor)	31-Dec-13
1371/07	Mitre	Tebuconazole	broccoli (outdoor)	31-Dec-13
1371/07	Mitre	Tebuconazole	calabrese (outdoor)	31-Dec-13
1371/07	Mitre	Tebuconazole	cauliflower (outdoor)	31-Dec-13
1367/07	Mitre	Tebuconazole	collard (outdoor)	31-Dec-13
1397/05	Orius	Tebuconazole	broccoli (outdoor)	31-Dec-13
1397/05	Orius	Tebuconazole	calabrese (outdoor)	31-Dec-13
1397/05	Orius	Tebuconazole	cauliflower (outdoor)	31-Dec-13
1395/05	Orius	Tebuconazole	collard (outdoor)	31-Dec-13
1326/07	Orius 20 EW	Tebuconazole	broccoli (outdoor)	31-Dec-13
1326/07	Orius 20 EW	Tebuconazole	calabrese (outdoor)	31-Dec-13
1326/07	Orius 20 EW	Tebuconazole	cauliflower (outdoor)	31-Dec-13
1330/07	Orius 20 EW	Tebuconazole	collard (outdoor)	31-Dec-13
1330/07	Orius 20 EW	Tebuconazole	collard (outdoor)(spring greens)	31-Dec-13
0546/07	Riza	Tebuconazole	broccoli (outdoor)	31-Dec-13
0546/07	Riza	Tebuconazole	calabrese (outdoor)	31-Dec-13
0546/07	Riza	Tebuconazole	cauliflower (outdoor)	31-Dec-13
0545/07	Riza	Tebuconazole	collard (outdoor)(spring greens)	31-Dec-13
2121/07	Nemolt	Teflubenzuron	broccoli (outdoor)	31-Dec-13
2121/07	Nemolt	Teflubenzuron	brussels sprouts (outdoor)	31-Dec-13
2121/07	Nemolt	Teflubenzuron	cauliflower (outdoor)	31-Dec-13
3237/07	Biscaya	Thiacloprid	broccoli (outdoor)	31-Dec-14
3237/07	Biscaya	Thiacloprid	brussels sprouts (outdoor)	31-Dec-14
3237/07	Biscaya	Thiacloprid	cabbage (outdoor)	31-Dec-14
3237/07	Biscaya	Thiacloprid	calabrese (outdoor)	31-Dec-14
3237/07	Biscaya	Thiacloprid	cauliflower (outdoor)	31-Dec-14
3527/06	Basilex	Tolclofos-methyl	broccoli (outdoor)	31-Dec-13
3579/06	Alpha Trifluralin 48 EC (07406)	Trifluralin	collard (outdoor)	31-Aug-08
3219/07	Ipifluor	Trifluralin	collard (outdoor)	20-Mar-09
3510/06	Treflan (05817)	Trifluralin	collard (outdoor)	31-Aug-08
2131/07	Triflur	Trifluralin	calabrese (outdoor)	31-Aug-08
2131/07	Triflur	Trifluralin	collard (outdoor)	31-Aug-08
1895/07	Trimaran	Trifluralin	collard (outdoor)	31-Aug-08

Notes:

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

Appendix 13 Guidelines on minimising pesticide residues

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

Active ingredient	Target: pest, weed, disease	Current position	Suggested guidelines
cypermethrin deltamethrin	insect pests	Residues very occasionally found in <1% samples	Both deltamethrin and cypermethrin have a zero harvest interval. However, application on the day of harvest can lead to occasional residues being detectable. Whilst these residues are well within current MRLs it is advisable to avoid the application of these insecticides within 3 days of harvest.

Appendix 14 Control Points: LEAF & FLOWERHEAD BRASSICAS

LEAF & FLOWERHEAD BRASSICAS

- CS.60.1 You should provide evidence to show that you have taken into consideration soil type and variety when planning fertiliser application -

Protocol reference: Section 6.1
- CS.60.2 A nitrogen prediction system such as WELL - N should be used to calculate crop nitrogen requirement -

Protocol reference: Section 6.1
- CS.60.3 *Deleted 2004*
- CS.60.4 You should consider the use of seed treatments in preference to module drenches or granule treatments for the control of Cabbage Root Fly - Protocol reference: Section 8.10.1.1
- CS.60.5 You should provide evidence to show that you can justify the use of fungicides and do not apply them on a routine prophylactic basis -

Protocol reference: Section 8.10.2 (**Revised 2005**)
- CS.60.6 Evidence must be provided to show that polythene crop covers have been disposed of or recycled in the most appropriate manner -

Protocol reference: Section 4.5.4
- CS.60.7 Evidence must be provided to show that you ensure harvested product is not contaminated by or exposed to anything that could affect food quality

- Protocol reference: Section 9.4