



**Assured Produce**

**Crop Specific Protocol**

**CABBAGE**

**(CROP ID: 58)**



**January 2008**

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## Preface

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

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

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

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

All statements in this protocol containing the words "**strongly recommended**" (in bold type) will be verified during the Assured Produce assessment and their compliance will form a part of the certification/approval decision. The score required for these "**strongly recommended**" control points can be found in the "APS Members' Checklist".

## 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<sup>®</sup> 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 Products containing substances which have been revoked are shown on the PSD website (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](http://www.pesticides.gov.uk))

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

There may be changes for the following reasons:

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

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

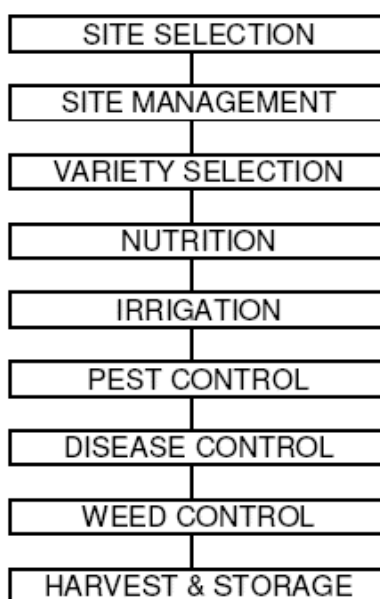
For pesticides on-label, only active substances are shown.

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

## 1 General introduction

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

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



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

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

## 2 Planning and records

See Generic Standards and/or Generic Guidance Notes.

## 3 Site Selection

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

### 3.1 Site history

#### 3.1.1 Climate

The crop can be grown throughout the UK, although wetter areas in the West can increase the risk of ringspot. 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 cabbage. 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.

### 3.1.4 Position

#### 3.1.4.1 Access

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

#### 3.1.4.2 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.

#### 3.1.4.3 Obstacles

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

#### 3.1.4.4 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, when using ground based vehicle mounted/mounted sprayers is prohibited within 5 metres of the top of the bank of the 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.*

*Brassicac crops 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**

Good drainage is essential. 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 carried out in very low pH situations. Cabbage can be grown on a wide range of soil types, but lighter sandier soil types will require irrigation. One should also consider the damage caused by harvesting on heavy soil types particularly with winter Cabbage. The heavier soil types may also be difficult to obtain a good tilth for drilling in March or April.

Direct drilled Cabbage are 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 cultivation, will help to maintain soil structure. Roots will not penetrate a compacted or smeared soil layer and high yields will not be produced unless the plants can root deeply.

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

*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 crop rows are left out for the passage of a tractor with wide tyres, facilitates easy fertiliser applications, spraying, irrigation and harvesting machinery access, in addition to confining wheelings to a designated area.*

### **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. Market for which the crop is grown.
- c. Costs of production.
- d. Disease control.

Increasing plant population results in reduced Cabbage size and delayed maturity. Plant population is more important than the spatial arrangement of the plants.

### 4.5.2 Sowing

#### Seedbed

- i. Seed can be drilled under glass, polythene tunnels, or polythene protection in the field, from mid-February, for subsequent transplanting to satisfy the earliest markets. Early varieties may tend to bolt under some conditions.

For further information on the use of field plastics, see Section 4.5.5.

- ii. Drilling without protection, for subsequent transplanting, can take place from early March (if the soil conditions are suitable) to early June for most Cabbage types except spring greens. Under poor conditions and low temperature deferred sowing dates are preferable.

The seed should be set at a constant depth of 18-20 mm, to ensure even emergence. Cabbage root fly control may be required (see Appendix 4).

#### Direct drilling

With the exception of spring green production, this system is rapidly falling from favour. It is generally used where crops are grown at close spacing, but is sometimes used for widely spaced crops. The method requires greater precision to establish the crop than transplanting.

With direct drilling:

- i. land is occupied for a longer period.
- ii. expensive hybrid seed requirements are higher.
- iii. less labour is involved than with transplanting.
- iv. specialised transplanting equipment is not required.
- v. unlike transplanting, there is less pressure to establish the crop in mid-summer, possibly in dry conditions.

There is no advantage in using pelleted seed. Seed priming is a technique that can bring greater uniformity and speed of emergence to field sown crops.

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.

#### Drilling into soils liable to cap

Minimum pressure should be applied over the rear wheels of the drill. Also certain drill accessories should be considered, such as:

- a. **Anti-capping wheels:** Twin rear wheels which 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.

Chemicals for the control of Cabbage root fly may be applied simultaneously at drilling (see Appendix 4)

### 4.5.3 Transplanting

#### **Propagation.**

*The majority of the 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. They also provide a system that facilitates the application of a cabbage root fly insecticide treatment that 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 insecticides). 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 growers with irrigation if the soil is dry or the weather hot or windy, water should be applied immediately post planting.

#### **Propagators**

Under EC 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 for 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.

#### **Bare root plants**

Bare root plants pulled from plant raising beds should be laid in shallow layers in trays and immediately

protected from exposure to wind and bright sunshine.

If planting is interrupted after the plants have been pulled, they can be stored at 5.0°C, with a relative humidity of 90-95% for up to two weeks.

#### 4.5.4 Early production under covers

Although mainly used for early production of summer primo and savoy cabbage, covers are occasionally used for small areas of white and red cabbage.

This technique needs easily worked soils with excellent structure and with the exception of the silts in Lincolnshire, growers usually need irrigation facilities.

Wide sheets, 10-14 metre wide, of perforated polythene are the most economical for covering. There is a disadvantage with narrow sheets due to an "edge effect". Before laying plastic, it is important that plants are strong enough to carry weight of covers. Alternatively, plant in shallow ridges so that soil may support 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 of the herbicide or possibly by the drying out of the soil surface. It is important that individual herbicides are applied to a very moist soil, or on soil moistened before the crop is covered with film, in order to improve the performance of the herbicide

Physiological problems soon arise if covers are left on too long. 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 usually only justified on early crops that command a 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

### 5.1 Choice of variety

#### Types of Cabbage

Cabbages can be divided into six types, depending on leaf structure, density, colour and time of maturity.

*None of the current commercially important varieties have resistance to all the five major diseases, (ring spot, Alternaria, light leaf spot, white blister and club root). Varieties differ in their susceptibility to powdery mildew. The National Institute of Agricultural Botany (NIAB) records and publishes varietal susceptibility listings.*

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

With the exception of spring greens, most varieties in current commercial use are hybrids.

#### Spring greens (also known as Cabbage greens or collards)

The Pesticide Safety Directorate defines collards, for the purposes of pesticide approvals, as : “varieties of cabbage *Brassica oleracea* var. *capitata* grown for harvest as spring greens before the ‘head’ has formed.”

Usually over wintered in the juvenile stage and cut from March to May, spring greens are now available in the winter period from Cornwall and Thanet, with production spreading to other areas as spring temperatures increase. Traditionally required in the summer by the wholesale markets, multiple retailers have developed an all year round market for bagged compact greens with a minimum of stem and inedible outer leaf. Semi-hearted varieties are acceptable especially in the late spring, e.g. the Hispi types, which also have a limited late summer/autumn trade. Recently multiple retailers have developed a six month sales period for a single piece, hearted, 450 g., Hispi-type Cabbage pack.

Irrigation is essential on all soils, except silts, for the summer production of the 'spring greens'. Pointed-hearted Cabbages of this type are available throughout the year.

The crop is grown at a high plant density and may be either direct drilled or grown from transplants. Germination may be inhibited in drilled crops due to soil capping (see Section 10).

When direct drilling, the high cost of hybrid seed, together with the shortage of good hybrids for the winter period, leads to mostly open-pollinated varieties being grown. Even with hybrids a lot of variability is evident.

Trials have shown that two-thirds of the variation in weight at harvest is associated with variation in seedling emergence, even when the spread of emergence is only five days. Much of this variation is associated with sowing depth as seedlings from small seeds emerge slightly later. Also for several days after emergence, seedlings from deep sowings grow at a slower rate than those from shallow sowings. Plant density studies have shown that even at the wide spacings used commercially, the growth of later emerged plants is suppressed by competition from larger neighbours.

### **Nitrogen top dressing**

Often applied as ammonium nitrate but nitrate of soda or sulphate of ammonia is sometimes used; sulphate of ammonia has been shown to be more effective than the nitrate forms in the wetter areas of the South West, but the choice is largely governed by price and availability.

*Where nitrogen top dressings are broadcast over the crop there is a risk of scorch and subsequent Botrytis infection. To minimise this risk, application should be made when the crop is dry or very wet so that as little as possible sticks to the foliage.*

### **Pests**

With the overwintered crop the most damaging and expensive pest is the wood pigeon!

### **Disease**

The main problems can be ringspot, *Alternaria*, light leaf spot and mildew (see Section 16). In the southern or western areas of England, ringspot and light leaf spot are major problems throughout much of the year.

Trials in Cornwall, under low disease pressure, showed that no one treatment produces a significant yield response or improved leaf quality. Low levels of disease, therefore, do not warrant routine fungicide spray treatments unless marketability is likely to be affected.

### **Harvesting and packing**

Customer preference is for greens with entire, medium deep green leaves with a high leaf area relative to vein, mid rib and stem, and of fresh appearance. A typical specification is 2-5 pieces per 500g bag. Care must be

taken not to include yellowing leaves or those fouled by mud.

The cost of harvesting and marketing can amount to at least 80% of the total cost of production, half of which may be the labour for cutting.

All field-packing rigs must conform to Health and Safety Executive standards and specific end market requirements.

With this leafy product, rapid cooling is essential especially in the summer period.

### **Early summer cabbage (Primo)**

These round cabbage varieties are the first types of a new season. Certain varieties are prone to bolting when sown early. Production begins in mid to late May.

Most varieties are now hybrids. The earliest is a savoy x white cabbage (viz. Spring Hero). The over-wintering crop is sown in August, which is ready for cutting in May. Most of the other early Primo varieties are derived from Copenhagen Market or Golden Acre types.

For the early crop (transplanting using blocks, modules, or bare root transplants) is essential and maturity ranges from approximately 65 to 76 days after transplanting. On the early crops the use of plastic or non-woven polypropylene fleeces can advance maturity by up to 14 days. Unlike polythene, non-woven polypropylene can be left on the early crop almost up to cutting, as lower temperatures prevail under the fleece. Irrigation may aid early maturity in the event of dry weather during May and June.

### **Pests**

Routine brassica pests need controlling at an early stage (see Appendices 4, 5, and 6.)

### **Diseases**

With early primo varieties, application of fungicides is generally not justified.

### **Harvesting**

This type of Cabbage quickly becomes over-mature and splits. The glossy young green leaves are especially prone to bruising.

### **Late summer/autumn cabbage**

Continuity of production is possible from the early primo types in May and June straight through to November. A dark green cabbage with a favourable taste is generally the requirement now.

These generally round cabbages are sown from March to May, maturing from July to October. They can be either the round Primo type, or the Christmas Drumhead January King type, sown in March or April. The latter can be prone to form rosettes and varieties should be chosen with care.

This crop can be either direct drilled or transplanted. Transplanting is preferred due to easy maturity programming and uniformity at maturity.

### **Pests**

Cabbage root fly, aphids and caterpillars are the most common. In the lifetime of the first and second generation cabbage root fly, preventative measures need to be taken. Spraying for aphids and caterpillars should commence when the pests appear, taking note of any threshold levels and ensuring to use insecticides

that preserve beneficial predators.

### **Diseases**

Unless disease levels are very high, it should be possible to grow the crop without application of fungicides in the field. Where disease levels are confined to the outer wrapper leaves, these are discarded when cutting, thus a small amount of infection on these leaves is not critical.

### **Winter cabbage (January King and green types)**

Winter cabbages are grown for harvesting from November to early March.

Cross breeding between cabbage types has occurred, thus Savoy x white Cabbage has resulted in varieties like Colt, Tundra and Celtic. Similarly, January King and white Cabbage are the parent types of varieties like Winterton and Savannah.

These varieties are sown in May/early June for harvesting from mid November onwards. It is preferable to select a variety with a short internal stalk.

### **Pests**

Aphids, etc. should be treated as per autumn Cabbage during the growing season. Pigeons and rabbits can damage crops during the winter.

### **Diseases**

Low levels of disease infection on the outer leaves can be ignored but where build-up becomes severe, eradicant fungicides must be applied before the marketable head is affected. The most serious disease is usually ringspot. Correct identification is essential to determine the correct fungicide (See Appendix 7).

### **Harvesting**

In the winter, preferably, cabbage should not be cut frozen when frost has penetrated the cabbage, because quality problems may occur when plant tissue thaws.

In most multiple retailer specifications for round green-hearted Cabbage, one outer ring of loose leaf is allowed. In the spring the internal stalk to leaf ratio varies. The head size specification is usually 700 g. with a maximum of 1.2 kg.

Packing rigs must comply with statutory Health & Safety regulations and specific end market requirements. Placing the cabbage heads directly into the final packaging in the field reduces handling and thus potential damage.

Packed cabbages must be quickly transferred to the packhouse for final quality checks before cooling.

### **Winter white & winter red storage cabbage**

Grown and stored using either simple ambient barn storage, sophisticated cold storage or controlled atmosphere storage. The two latter systems will give availability for up to nine months.

These cabbages are required for both home consumption (cooked and raw) and also for processing. The preferred size for retailing is usually 500 g. to 1.2 kg, whilst processors usually require a minimum of 2.5 kg, with an optimum weight around 3 kg.

These cabbages are now available for 12 months of the year either from field or store.

Winter white cabbage for processing requires a long period of steady growth to ensure a high yield with good storage potential. True winter white types are sensitive to day length and are difficult to produce from the field before the end of August. Summer types are often used as a "filler" in the July/August period but are disliked on ground of colour, texture and conformation, thus this Cabbage is often blended with stored winter whites.

The "high density crop" can be direct drilled or transplanted. The wide spaced crop is usually transplanted and modular transplants give a more even maturity.

### **Pests**

Normal brassica pests should be controlled when they appear. Do not apply routine prophylactic sprays.

### **Diseases**

It is essential that the crop be kept disease free. Secondary storage rots develop on leaves attacked by primary pathogens. The most troublesome is likely to be ringspot, although all the common brassica leaf pathogens can occur on this crop. Apply fungicides in the field only when onset of disease is noted.

Harvesting - see 9.4.1.

### **Savoy cabbage**

Savoys are probably the most frost tolerant type. With early production and using short-term refrigerated storage at the end of the season, they are available from July to early April.

Savoy cabbage is characterised by blistered or wrinkled foliage that is dark green and has very little bloom.

Nearly all varieties are now F1 hybrids. Choose a variety with a compact habit and good internal structure, and density. Savoys are very winter hardy, but care should be taken if long periods of hard weather necessitates having to cut frozen cabbage. Frozen cabbage bruises easily and must be allowed to thaw out completely before sale.

The full range of brassica pests and diseases attacks this type of cabbage.

## **6 Nutrition**

### **6.1 Nutrient requirement**

#### **Macro-nutrients**

Excessive use of macro-nutrients is not only wasteful, but can be costly and have a detrimental effect on groundwater quality.

Nitrogen in particular must be tailored accurately to the precise needs of the cabbage 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 released from the organic breakdown of the previous crop residues, and predicts the total nitrogen required. Residual nitrogen testing also enables applications to reflect accurately the crop's need, taking into account soil residues, thus reducing the opportunity of excess nitrate 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 its 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, fields should be sampled and analysed 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 salt levels 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 U.K. may be located in designated nitrate vulnerable zones (NVZs). 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 waterlogged, 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.

## pH

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

## 7 Irrigation

The greatest response is likely to be obtained by achieving rapid establishment by irrigating immediately pre-sowing of direct drilled crops and (after planting out) with transplanted crops.

Plants under drought stress tend to be susceptible to pest attack; therefore irrigation helps improve yield and quality.

Summer Primo cabbages are the most likely to benefit from irrigation during the growing period. Typically apply 25 mm at 25 mm SMD and on soils of high available water capacity, apply 40 mm at 50 mm SMD during the growing period up to the end of August. Where water is limited satisfy the SMD up to 50 mm about 20 days before cutting. It is usually not economic to irrigate during the growing period with other types of Cabbage.

## 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](http://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](mailto:p.s.d.information@psd.defra.gsi.gov.uk) tel. 01904 455 775

### 8.3 Advice on the use of pesticides

See Generic Standards and/or Generic Guidance Notes.

### 8.4 Application of pesticides

See Generic Standards and/or Generic Guidance Notes.

### 8.5 Records of application

See Generic Standards and/or Generic Guidance Notes.

### 8.6 Protective clothing/equipment

See Generic Standards and/or Generic Guidance Notes.

### 8.7 Pesticide storage

See Generic Standards and/or Generic Guidance Notes.

### 8.8 Empty pesticide containers

See Generic Standards and/or Generic Guidance Notes.

### 8.9 Pesticide residues in fresh produce

See Generic Standards and/or Generic Guidance Notes.

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

*Assured Produce is aware that a key area in the production of fresh produce which requires continued attention by growers and their advisers is that of keeping pesticide residues to a minimum. 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 also better than cure, therefore where possible, an integrated approach is needed.

#### **Prevention:**

- 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.*
- Crop rotation.*
- Provide good soil structure, correct nutrition and irrigation if possible to ensure conditions to*

*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 eg. 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 it is 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 populations particularly peach potato aphid to many insecticides. It is important to alternate the use of different active ingredients to enable the best chance of control with the existing range of actives.*
- vii. *Use the minimum effective dose rates, normally being that recommended. Do not reduce dose rate for peach potato aphid.*
- viii. *Consider use of natural and biological methods of pest control, if available.*
- ix. *Avoid spraying, or allowing drift into grassy banks, dyke sides, hedgerows etc., these can provide a reservoir of insect predators, such as ladybird larvae, hover flies, ground beetles etc. However consider the implication of buffer zone restrictions on certain chemical uses.*
- x. *Carefully consider also the anticipated harvest date when selecting the appropriate product. Ensure you have enough time for the harvest interval to elapse prior to harvesting.*

For various reasons the use of some approved pesticides may not be acceptable to processors. In order to conform to such requirements, 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/purple discoloration of the leaves and the plants may wilt and die. 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 for the peak of the first generation, irrespective of whether the crop is direct drilled or transplanted.

For autumn-planted cabbage maturing in the spring, treatment for cabbage root fly is unlikely to be necessary.

*The eggs of cabbage root fly are attacked by several beetle species. These beetles remain in the soil for long periods; 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 stem base of brassica to predict the size of the next generation and non-selective water traps to catch adult flies. The 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 HRI computer prediction model, will 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 the two rough leaf stage, if this is later. 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. **Note: there is no approval for use of spinosad on collards.** Do not use on cells smaller than about 14 ml capacity.

Chlorpyrifos should not be used to treat blocks/modules which will be planted out before April 1<sup>st</sup>. 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 have been 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<sup>®</sup>):** It is recommended that growers consider the use of this treatment as the levels of active ingredient used are minimal resulting in considerably lower operational exposure and much less active ingredient incorporated into the soil than with other control systems. **Note: the EU approval for Gigant has expired. Treated seed may however still be used for 2008 cropping.**

It is **strongly recommended** that growers consider the use of seed treatments, if 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 (as above), should not normally need further treatment in the field but there are occasions where subsequent granule treatment may be necessary:

- a. Where, due to planting delays, copious irrigation has been applied after treatment and considerable time has elapsed before planting which may have led to the leaching of the insecticide.
- b. Insufficient insecticide applied by propagator (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. This necessitates covering the module with soil and this 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. Sub-surface treatment is preferred for both environmental and efficiency reasons.

## Treatment methods

### Granules

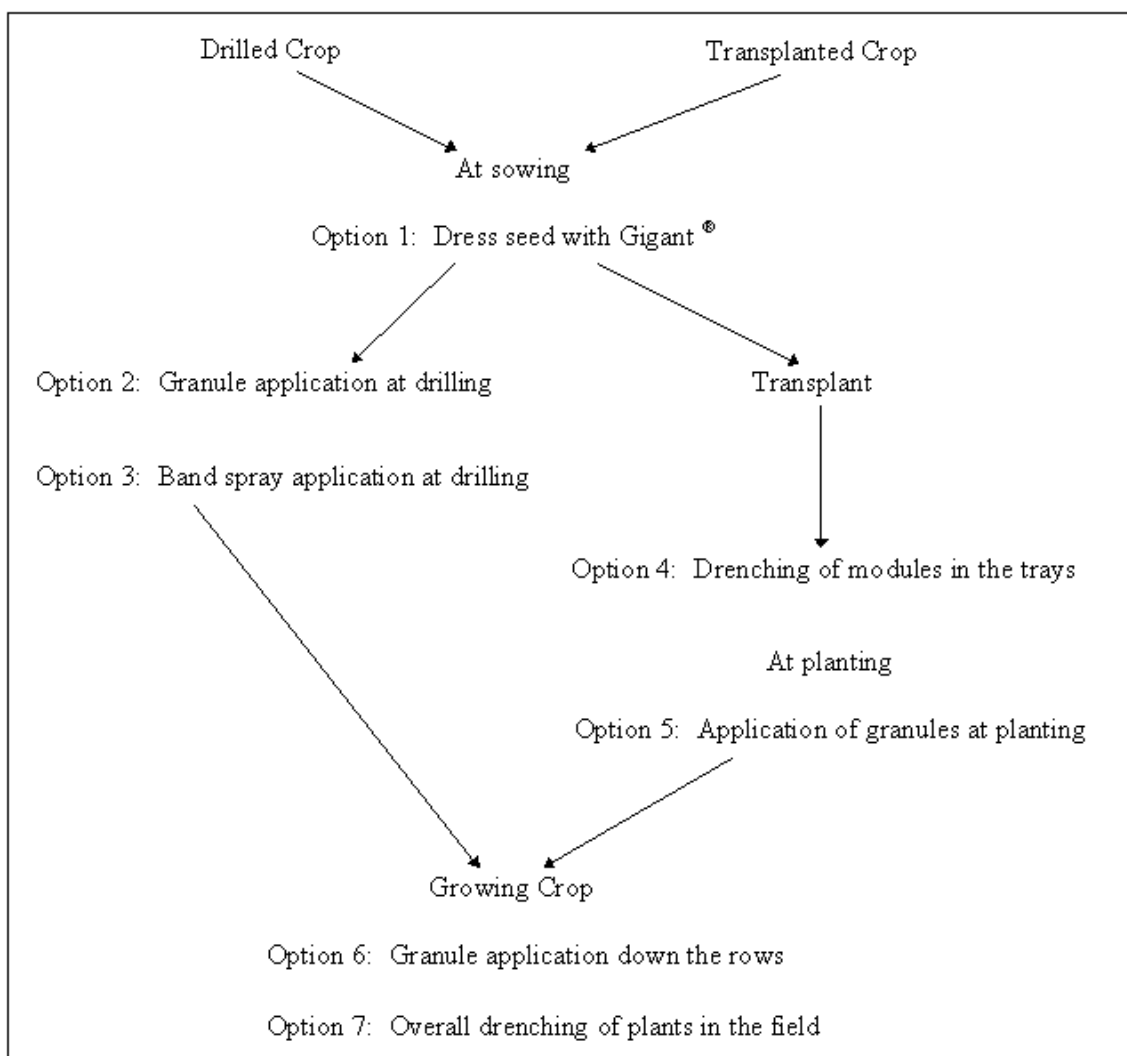
Band treatment gives the most efficient placement and is recommended for all granules, but recommendations may specify the exact method to be used, (e.g., surface band or bow wave, width of band etc.). Applicators must be calibrated in the field before use.

There are noticeable increases in the speed of degradation of some soil applied granules. As a result the persistency of the product may possibly be much shorter than that quoted by the manufacturer.

### Sprays

Several insecticides are currently approved (see Appendix 4), however, these should only be used in areas of low cabbage root fly activity. Time the application as stipulated on product label.

### Summary of cabbage root fly treatments



#### 8.10.1.2 Brassica aphids (*Brevicoryne brassicae* and *Myzus persicae*)

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 to the fresh Cabbage crop.

**Mealy grey aphid**(*Brevicoryne brassicae*)

Widespread pest of cabbage 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 rarely causes significant damage but 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 are currently known to exist with regard to the pymetrozine (Plenum®), nicotine or the neo-nicotinoids ie. imidacloprid (Gaucho®) and thiacloprid (Biscaya®). Use of these four actives should be made where there has been a previous history of resistance or where resistance 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 these.*

*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 field-walking techniques are being determined by Warwick HRI/ADAS currently.*

**Chemical control:** Numerous insecticides are currently approved for use and should be selected from the list in Appendix 5. Select insecticides with the least harmful effect on beneficial insects and avoid broad-spectrum insecticides. For these reasons foliar sprays should be chosen for cabbage aphid control. Some synthetic pyrethroids, despite their reputations, often kill a wide range of beneficial predators.

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. Late in the season, from October onwards, control of cabbage aphid with pirimicarb may fail.

During dry periods the uptake of systemic insecticides is reduced.

Current work at HRI is focussing on the development of 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 Cabbage caterpillars

Caterpillars of many species attack brassicas and may appear at almost any time between mid-May and October, although the degree of infestation varies from season to season. The damage caused depends upon the species responsible. Some species larvae, when nearly mature, are difficult to kill with insecticides and cause considerable spoilage. *Others, 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 needed insecticides need to be applied whilst the caterpillars are still young. To help in crop walking and establishing pest thresholds, pheromone traps are available to catch the moths.

**Cultural control:** *Frequent crop walking is essential to identify both the caterpillar species and natural predators; some of these numerous 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 chemical control may not be necessary.*

**Chemical control:** Check crops regularly and apply insecticides when caterpillars found. List of currently approved insecticides in Appendix 6.

Treatment of only the crop headlands and the periphery of the field may be sufficient to control the caterpillars, as the adults will tend to attack the field from the margins.

Consider using more specific control measures such as *Bacillus thuringiensis* and diflubenzuron that will not have such a damaging effect on beneficial predators.

### 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 20 mm 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 occasionally capable of inflicting damage to summer primo cabbage or may cause contamination issues.

**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 leafy brassicas. Pyrethroids should be particularly considered because of their subsequent repellent effect. 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.

**Cultural control:** *Consolidate soils to inhibit slug movement where necessary. Surface bait to determine need and timing of further control measures.*

**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 that are beneficial in other areas of pest control.

#### **8.10.1.7 Cabbage stem weevil (*Ceutorhynchus quadridens*)**

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

Some granular treatments applied for cabbage root fly will 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 problems 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

- a. 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.
- b. If a pesticide is required avoid use of broad spectrum insecticides which can have a harmful effect on beneficial insects.
- c. 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

Cabbage 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, and use of a disease forecasting system where applicable, are an important element in minimising fungicide use.*

Most of the major fungi cause spots or blemishes on the cabbage leaves/head rendering it unmarketable. These diseases are prevalent in the main production areas in most seasons. The spread of oil-seed rape growing, especially spring sown and proliferation of rape volunteers on set-aside land have aided disease spread (example, ringspot was traditionally a disease only seen in the wetter western areas of the UK). End market tolerance of markings on the heads of cabbage is invariably zero.

*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 brassica. In intensive brassica areas, where this is not possible, plough in plant remains immediately 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 good.*
- c. *Use resistant varieties (where available) whilst respecting the need to meet the required agronomic, quality parameters and eating requirements. Refer to the NIAB assessment sheets for the various resistance levels for each variety.*

### 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, ie. avoid poorly drained soils, the presence of imposition or 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.*

- b. *Where fungicidal control is needed, 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 *Check that use within 5m of the top of the bank of water courses is approved*
- c. *Carefully consider anticipated harvest date and ensure the selected chemical has an appropriate harvest interval.*

Only winter white and red cabbages destined for storage are likely to need fungicide treatment. Other types of winter maturing Cabbage are only likely to need treatment in very wet, humid conditions.

#### **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 blue and wilt whilst the plant may be stunted or even die. This disease is of considerable significance in some cabbage production areas, particularly where soil pH is naturally marginal. The 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 (>7.5) 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.*
  - ix. *Clubroot resistant cabbage varieties are now available for some cabbage types, where marketability is not affected use of these varieties should be considered.*

**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 in field crops is impractical.

**Cultural control:**

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

**Chemical control:** Fungicides currently approved for use in propagation both as pre-sowing drenches or pre-planting treatments listed in Appendix 8 and 9.

#### **8.10.2.3 Downy mildew (*Peronospora parasitica*)**

This disease is endemic in propagation under glass but in the field infections only become significant when mild wet weather conditions prevail in late autumn. This fungus is both air- and soil-borne and may affect young plants via the roots. Spores are produced on infected plants and are distributed by air currents or rain splash, re-infecting plants via the leaves. 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.

**Cultural control:**

- i. *Good glasshouse hygiene is essential.*
- ii. *Good management as outlined in Section 8.10.2 (Introduction) is essential.*
- iii. *Varieties vary in susceptibility - Therefore choose the more resistant varieties, provided they give the other agronomic features required.*
- iv. *Increase rotation.*

**Chemical control:**

- i. *In propagation, routine treatment, both on a preventative and eradicant basis, is essential.*
- ii. *Currently approved products are listed in Appendix 8 and 9.*
- 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*)**

Usually seed- and air-borne, these fungi are also soil-borne following the incorporation of infected crop residues. All brassica crops including oilseed rape and cruciferous weeds are potential sources of the disease.

Symptoms range from small discrete black spots (which can be confused with those of powdery mildew and ringspot) to circular zonate spots, up to 12 mm in diameter. The latter have greyish, brown or almost black centres, which the case of *A. brassicicola* may be covered with sooty spores. In the field, spots caused by the two species are indistinguishable. The spots may be surrounded by chlorotic haloes and severely affected leaves may show extensive yellowing. With ageing the centre of the spot appears thin, dry and papery and may fall out giving a 'shot-hole' appearance. Elongated dark brown lesions are found on stems and leaves. The influx of *Alternaria* normally coincides with the harvest of the oilseed rape crop in July.

*Alternaria* may be controlled by seed treatments on young plants in propagation. These treatments use very small amounts of fungicide compared to overall applications. In the field, the disease is favoured by warm moist conditions and spreads by wind-borne spores.

##### **Cultural control:**

- i. *Good glasshouse hygiene is essential.*
- ii. *Good management as outlined in Section 8.10.2 (Introduction) is essential.*
- iii. *Plough in crop residues as soon as possible.*
- iv. *If possible, isolate brassica crops from each other, particularly oilseed rape.*
- v. *Collect intelligence about problems in oilseed rape crop.*

##### **Chemical control:**

- i. Currently approved seed treatments are listed in Appendix 8.
- ii. Currently approved fungicides are listed in Appendix 7.

Iprodione will give some control of *Alternaria* .

#### **8.10.2.5 Ring spot (*Mycosphaerella brassicicola*)**

This disease is both seed-borne and soil-borne through plant debris in the soil. Infection and disease development is dependent on high humidity and temperatures of 10-20°C. Traditionally troublesome in the wetter southwest but now endemic in all main production areas. Periods of frequent rainfall appear to be critical for epidemic development.

The disease first appears on lower leaves as small circular necrotic, brown or purplish-black spots that gradually enlarge to 1.5 cm in diameter. As the ringspots develop, concentric rings of dead tissue are formed, surrounded by a narrow water-soaked area or yellow halo. With age, the ringspots appear grey with the distinctive fruiting bodies of the fungus arranged in concentric rings mainly on the upper leaf surface. Severely affected leaves quickly become yellow and prematurely wither.

The ringspot lesions are grey when dry, but are black and have a water-soaked appearance when wet. Yield may not be affected but quality is drastically reduced.

##### **Cultural control:**

- i. *Isolate out-door plant beds.*
- ii. *If possible, have a wide brassica rotation.*
- iii. *If possible, isolate Cabbage crops from other brassica.*

**Chemical control:** Currently approved fungicides are listed in Appendix 7.

Tebuconazole, difenoconazole, boscalid/pyraclostrobin and the new approval for tebuconazole/trifloxystrobin (not collards) will enable growers to achieve much better eradicant control and if used strategically will reduce the number of preventative sprays quite markedly.

#### **8.10.2.6 White blister (*Albugo candida*)**

White blister was an occasional problem that occurred in most seasons, but it is now becoming more frequent. It occurs widely in the major brassica growing areas but shows considerable seasonal variation in severity. All the aerial parts of the plant may be affected. The fungus survives in the soil or on plant debris. Initially, small green blisters are produced which later form white patches, at first small and glossy but later turning powdery.

Late in the season the white patches may turn brown. They first appear on the lower surfaces of the leaves and on stems, and marketable quality is reduced.

The strains that attack cruciferous weeds such as shepherds purse are distinct and will not transfer to cabbage.

**Cultural control:** *Plant beds should be in a dry open position.*

**Chemical control:** Currently approved fungicides listed in Appendix 7.

#### **8.10.2.7 Powdery mildew (*Erysiphe cruciferarum*)**

Powdery mildew is spread by wind-borne spores from affected brassica crops. Disease appears as small patches of thin white fungal growth on either leaf surface and on the stem. In severe attacks, the whole leaf surface is colonised. After frost, the disease may also show discrete black spotting which could be confused with *Alternaria* symptoms. Disease severe in hot summers as infection is favoured by warm (15-20°C) conditions with periods of high humidity.

**Cultural control:** *If suitable, apply nitrogen as dictated by soil analysis and computer prediction (Heavy applications of nitrogen favours disease development). In dry growing seasons, plants under water stress appear to be more susceptible, particularly shallow-rooted varieties, therefore, if available, irrigate accordingly.*

**Chemical control:** Fungicides only warranted on the more susceptible varieties in high-risk years. Currently approved fungicides are listed in Appendix 7.

#### **8.10.2.8 Light leaf spot (*Pyrenopeziza brassicae*)**

This soil-borne fungus comes from infected debris and is also spread by rain splash and wind from neighbouring infected brassica crops, particularly oilseed rape.

Lesions are initially superficial, developing mainly on the upper surface of the older leaves and producing a diffuse silvery appearance. Young lesions show little discoloration but become paler in the centre and bleach with age. Individual spots may merge to produce large bleached patches, particularly on the lower leaves. Around the edge of the lesion, black speckling and concentric rings of white spore droplets can be found. Spread and development are favoured by cold wet conditions.

**Cultural control:** *Infected crop residues should be carefully and quickly ploughed in. Adopt a minimum 4 year rotation if possible to reduce the risk of carry-over on debris.*

**Chemical control:** Currently approved fungicides are listed in Appendix 7.

#### **8.10.2.9 Canker (*Phoma lingam*)**

This disease is both seed-borne and soil-borne from infected debris. The fungus produces well-defined spots, with ashen-grey centres, on the upper side of the leaf. On the Cabbage stems, near the base and on the tap root, brown or purplish areas develop, which turn black.

**Cultural control:** *A minimum of four years rotation on infected fields. Do not grow outdoor plant beds adjacent to infected sites.*

**Chemical control:** Currently approved fungicides are listed in Appendices 7 and 8.

#### **8.10.2.10 Root rot (*Phytophthora megasperma*)**

This soil-borne fungus disease is occasionally seen on heavier or poorly drained soils. It attacks roots and stems leading to a severe pungent rot. The leaves wilt.

**Cultural control:** *Avoid wet heavy, poorly structured soils.*

**Chemical control:** None available.

#### **8.10.2.11 Grey mould (*Botrytis cinerea*)**

A fungal disease that appears on the leaves as a grey growth or soft brown rot, it is usually associated with damage or the retention of dead and decaying lower leaves. The disease is spread by wet weather and high humidity. *Botrytis* can be difficult to control.

**Cultural control:** *Avoid lush soft growth from excess nitrogen.*

**Chemical control:** Currently approved fungicides are listed in Appendices 7 and 8. Fungicides applied for *Alternaria* control should give some control.

#### **8.10.2.12 Black rot (*Xanthomonas campestris*)**

This is a bacterial disease commonly found on savoy x white cabbage, late autumn or overwinter cauliflower and occasionally on Brussels sprouts.

Field infections are nearly always seed-borne or spread during propagation but then become endemic by surviving on incorporated residues. The symptoms are V-shaped chlorotic lesions on the leaf margins. Within the lesions the veins become blackened and a characteristic ring of vascular tissue can be seen when the stalks of affected plants are cut crosswise. The disease can develop very rapidly in warm damp conditions.

**Control:** *Plant debris is a source of infection together with cruciferous weeds (eg. shepherd's purse). Quick removal or soil incorporation of crop residue is advised. Where the disease is identified a rotational break of at least two years should be practised.*

**Seed testing:** *Major seed lots are batch tested. A negative result does not guarantee complete freedom from the disease but more usually subsequent disease expression is economically not significant.*

*If batches of seed are infected, hot water treatment is the only approved method of control but the can affect seed vigour.*

#### **8.10.2.13 Virus diseases**

- a. Turnip Mosaic (TuMV) virus is probably the most severe virus that attacks cabbage. Dark necrotic rings and spots on the older leaves of plants associated with severe stunting are the typical symptoms.

- b. Cauliflower Mosaic virus (CaMV) is more common. The symptoms are vein clearing etc. followed by vein banding with stunted growth and distorted leaves. Affected plants are usually very susceptible to frost injury. Cauliflower and turnip mosaic virus's often infect the same plant. Peach cabbage aphid spread both viruses. Aphicides will not prevent introduction of virus but will restrict subsequent spread.
- c. Turnip Yellows Virus (TYV) formerly Beet Western Yellows Virus (BWYV) commonly affects brassica crops. Symptoms vary considerably as the virus is commonly associated with CaMV or TuMV. Recent work at Warwick HRI suggests that TVY is implicated in tipburn in processing storage cabbage.

**Cultural control:** *If possible, grow apart from other brassica crops. Isolate outdoor beds from other growing brassica. Destroy and plough in immediately, especially overwintered crops, and all other brassica crop residues.*

**Chemical control:** Control aphids, especially in outdoor plant beds or early in the life of direct drilled crop. Currently approved aphicides listed in Appendix 5.

### 8.10.3 Physiological disorders

None stated.

### 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 eg. Pennycress is 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 lines 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. Generally approved herbicides for fresh Cabbage 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 , drenching and storage

All harvesting equipment must comply with the relevant agricultural safety provisions and the Health and Safety at Work regulations. 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.

Cabbages are at risk from physical damage such as cuts, grazes and bruises, all of which speed up post-harvest deterioration as well as affecting appearance. Cabbage easily bruises when full of water or following a frost; therefore, efforts should be made to reduce any large falls or excessive abrasion on the harvesting machine. Although the Food Safety (General Food Hygiene) Regulations exempt harvesting, the more sophisticated packing rigs will need a hazard analysis assessment. The FPC will shortly be publishing a code of practice covering food safety on field packing rig.

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

### 9.4.1 Harvesting

Only firm mature heads should be selected for storage and these should be harvested before they suffer damage from frost. Cabbage should be in store by early to mid November as frosts below -3°C reduce storage life.

Do not start to cut until early morning ground frosts have disappeared. If possible, harvest in dry conditions to minimise mud splash.

Harvesting by hand is currently the only acceptable method. Loose outer leaves must be stripped off before cutting commences. Heads must then be cut cleanly with a clean sharp knife, leaving approximately 10-15mm (¼-½ inch) of stem. Closer cutting may lead to splitting and long jagged stems may cause damage when Cabbages are being loaded into boxes. To prevent disease spread knives should not be stuck in the ground or used to cut up rotten heads in the field.

Heads should be carefully placed into storage boxes as rough handling causes bruising and splitting which promotes early rotting. It is also important that the Cabbage and boxes are kept free of soil. Avoid windrowing cabbage since this can also cause soil contamination and lead to infection by *Phytophthora*. Do not put storage boxes on the ground in the field; preferably load whilst on trailers or forklifts or stand boxes on pallets.

### 9.4.2 Drenching

Fungicides need to be applied to the cut storage Cabbage to control storage diseases immediately prior to loading into store.

Iprodione is approved for *Alternaria* and *Botrytis* control and metalaxyl-m is approved for *Phytophthora* control. Treatment with iprodione and/or metalaxyl-M reduces the amount of wastage occurring during storage by reducing the time taken to prepare the cabbage when unloading the store. In addition, there is often less secondary rotting in treated heads, provided they are left to drain thoroughly after treatment.

Fungicide treatment is by either dipping (immersion) or drenching using either hand lance or appropriate machinery to ensure that all surfaces of every Cabbage are covered in fungicide. Fresh solution should be made up when the existing solution becomes dirty and changed at least daily. Old solution must be disposed of in an approved manner.

Allow boxes of dipped/drenched Cabbage to drain and dry off the Cabbage using high airflows for the first two weeks in store. Maintain 0-1°C and 90-95% RH throughout the storage period and for controlled

atmosphere storage, 5% carbon dioxide and 3% oxygen is required.

### White Cabbage supply pattern

September-November	Direct from the field.
December-February	Can be from ambient, frost-free barn stores.
March - June	From cold stores.
July - August	From controlled atmosphere cool storage that tends to retain the colour, crisp texture and flavour better than air-stored samples.

### 9.4.3 Storage disorders

Poor handling and inadequate control of storage conditions can all lead to the rapid spread of fungal and bacterial disorders.

- a. **Grey mould**(*Botrytis cinerea*) : This common spoilage organism causes a brown soft rot which penetrates deeply into the head. It is easily recognised by the surface growth of grey mycelium and spores. Damage at harvest increases the incidence of this disease.

Other fungi such as *Alternaria*, *Mycosphaerella* and *Phytophthora* , may cause lesions which could lead to secondary invasion by *Botrytis* .

**Chemical control:** Pre-storage drench or dip with iprodione.

- b. **Dark leaf spot**(*Alternaria brassicicola*) : This airborne fungus (see Section 8.10.2.4) causes grey or black lesions that become dry and leathery in store. At low levels of infection it is unlikely lesions will be seen on the trimmed Cabbage when they are put into store, but spores, which germinate during storage, may be present on the heads.

The growing crop should be kept free of visible infection (see Appendices 7 and 8 for chemical controls).

**Chemical control:** Pre-storage drench or dip with iprodione.

- c. **Ringspot**(*Mycosphaerella brassicicola*) : This fungi must be controlled in the field, so that heads taken into store are free from any fungal lesions, which may lead to secondary *Botrytis* infection.

**Control:** See section 8.10.2.5 and Appendix 7, for field control measures.

- d. **Phytophthora rot** (*Phytophthora megasperma*) : This soil-borne pathogen (see Section 8.10.2.10) becomes active during wet weather. In store the disease spreads rapidly up the stem causing whole head losses, therefore, heads should be harvested when dry and without contact with the soil. Ensure cut heads are not windrowed, soil is not collected in bins, or that infection is spread by sticking knives into the soil.

**Control:** Pre-storage drench or dip with metalaxyl-m (SL567A<sup>®</sup>).

- e. **Bacterial soft rot**(*Pseudomonas marginalis*) : This very soft watery rot is particularly serious because it often causes whole head losses. Infection generally begins at sites of mechanical damage. In store these rots spread very quickly by contact and by "dripping on" to Cabbages below. As free water on the surface of the Cabbage head encourages the development of bacterial rots, thoroughly dry off any surface moisture at the beginning of storage and maintain an adequate airflow within the store during storage.
- f. **Leaf necrosis** : These symptoms frequently cannot be removed by trimming and their extent is only evident when the Cabbage is cut open or shredded during processing. The use of colloquial names and the often vague descriptions, make identification and comparisons of the various disorders difficult.

However, four clearly distinguishable necrosis symptoms occur.

- g. **Pepper spot** (*Black speck or spotted necrosis*) : The most serious and widespread of these disorders is characterised by the development of very small superficial black spots less than 1 mm in diameter which appear randomly distributed over the leaf surfaces. The spots typically, but not invariably, appear first on the outer leaves of the heads and progress inwards during storage. The symptoms are rarely seen in growing crops. In each spot necrosis starts in the stomatal guard cells and spreads to a few surrounding epidermal cells. Pepper spot is a physiological disorder, not associated with any fungus, bacteria or virus. Incidence and severity varies considerably between growing sites and from season to season.

*Varieties vary considerably in their susceptibility or tolerance to pepper spot. Therefore choose highly tolerant variety (see NIAB results).*

- h. **Large necrotic leaf spot** (*Black Spot*) : After pepper spot, this is the most common necrosis problem of stored Cabbage. The large brown or black lesions may be 5 to 10 mm in diameter and frequently coalesce to form irregular discoloured areas. Tissue in the centre of the spots becomes sunken and eventually collapses to leave a brown, papery membrane.

This disorder is the result of infection, usually early in the growing season, by aphid borne turnip mosaic virus. Therefore, prompt control of aphids with a systemic insecticide, whilst not preventing, may help to slow down spread of the disease (see Appendix 5).

- i. **Vein streak**: Similar to pepper spot and appears as superficial brown or black markings on the epidermis along the leaf midrib and petiole, occasionally spreading out along the larger veins. This infrequent physiological disorder rarely causes a serious problem.
- j. **Internal tipburn**: Although most types of Cabbage can be affected, tipburn is most commonly seen on stored processing white Cabbage. The margins of the inner heartleaves, especially round the vein endings, become papery and a discoloured grey or brown.

Varieties vary in susceptibility and recent research undertaken by Warwick HRI suggests that BWYV may be implicated.

- k. **Oedema**: This is manifest as small brown corky areas on the undersides of leaves. Recent research at HRI suggests that thrips are the main cause. They can even survive in cold stores. There appears to be differences between varieties in their resistance. Thrips need to be controlled in the growing phase of the crop.

## 9.5 Cooling

In the summer and in warm and wet autumns, Cabbages have a very high post-harvest respiration rate, especially in bulk bins. Unless cooled rapidly soon after harvesting, Cabbage will heat up and quickly become discoloured. Therefore, delays between harvesting and the commencement of cooling should be minimised. Causes of Cabbage deterioration are dehydration, microbiological attack and physiological changes, including browning of the butt. All are temperature related, therefore, 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 Cabbage temperature down to possibly a minimum of 6°C in 12 hours. Faster cooling rates are unnecessary and require very expensive cooling equipment.

Cabbages should be held in conditions where the relative humidity is higher than 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 ventilation.

Wet air coolers with positive ventilation such as ice bank coolers are ideal. Other suitable systems available use a 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 design information. The major disadvantages are the difficulty of cooling packaged produce and the need for moisture resistant packaging materials.

Once cooled, Cabbage must be held at the target temperature; this often involves a holding store. If the Cabbage need pre-packaging, they must be taken out of the primary cooling equipment, passed through the packhouse, then re-cooled prior to despatch.

## **10 Pollution control and waste management**

See Generic Standards and/or Generic Guidance Notes.

## **11 Energy efficiency**

See Generic Standards and/or Generic Guidance Notes.

## **12 Health & Safety**

See Generic Standards and/or Generic Guidance Notes.

## **13 Conservation issues**

See Generic Standards and/or Generic Guidance Notes.

## Appendix 1 Minor pests in fresh Cabbage

*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 Cabbage families. Although Cabbages 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 .*

### **Cabbage leaf miners**(*Phytomyza rufipes* and *Scaptomyza apicalis*)

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 minor 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 outer leaves and contaminate the head 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 as 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 that attacks 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 yield.

*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, damage is caused by the adults and the 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 of adults 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 .)

Leatherjackets 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. If this is high, it may be necessary to use an organophosphorus insecticide, applied pre-planting.*

#### **Turnip gall weevil**(*Ceutorhynchus pleurostigma*)

This localised and sporadic pest frequently found in southwest England. It attacks late-sown or late-planted Cabbage 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. Little can be done once an attack has started.*

#### **Swede midge**(*Contarinia nasturtii*)

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. High humidity favours 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 point. Attacks are very rare in the UK.

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

## Appendix 14 Control Points: LEAF & FLOWERHEAD BRASSICAS

### LEAF & FLOWERHEAD BRASSICAS

- CS.59.1 It is recommended that evidence be produced to show that you have taken into consideration soil type and variety when planning fertiliser application -  
Protocol reference: Section 6.1
- CS.59.2 It is recommended that a nitrogen prediction system such as WELL - N are used to calculate crop nitrogen requirement -  
Protocol reference: Section 6.1
- CS.59.3 *Deleted 2004*
- CS.59.4 It is recommended that you 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.59.5 It is recommended that you 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.59.6 Evidence must be provided to show that polythene crop cover has been disposed of or recycled in the most appropriate manner -  
Protocol reference: Section 4.5.4
- CS.59.7 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

## Appendix 2 Fertiliser requirements for Cabbages (kg/ha)

Based on DEFRA Fertiliser Recommendations (RB 209)

Nutrient (kg/ha)	Soil Index						
	0	1	2	3	4	5	6
<b>Nitrogen</b>	75	75	75	-	-	-	0
Overwintered spring greens*	340	300	260	0	0	0	0
Early-summer and autumn	340	300	260	220	170	60	0
Winter and Savoy (pre-Christmas cutting)	300	250	210	220 180	170 120	60 40	0
Winter white storage							
<b>Phosphorus</b> (all types)	200	150	100	50M	0	0	0
<b>Potassium</b> (all types)	300	250	200 (2-) 150M (2+)	60	0	0	0
<b>Magnesium</b> (all types)	150	100	0	0	0	0	0

### Notes:

\* Large, hearted Spring Greens can use up to 250 kg/ha nitrogen, but the smaller leafy Greens needed for "prepacks" may need considerably less. Applications of each top dressing should be in the range of 100-200 kg/ha of nitrogen and related mainly to stage of growth, but the potential marketing period and weather conditions should also be considered.

When Spring Cabbage follows a crop leaving substantial residues, reduce the phosphorus by half and the potassium by 60 kg/ha.

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 levels only maintenance amounts of fertiliser are needed.

*Well-rotted farmyard manure at about 25t/ha will provide adequate phosphate and potash at Index 3 for phosphate and potassium without additional fertiliser. All manures should be well incorporated to avoid microbial contact with the crop. At the lower indices the recommended rates shown in the table above should be reduced for each 10 t/ha farmyard manure applied by 15 kg/ha nitrogen 20 kg/ha phosphorus and 40 kg/ha for 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](http://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 <sup>(1)</sup>	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	Full	SOLA's Various see App. 12.	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	SOLA 0319/06	No Approval	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

<sup>(1)</sup> **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 <sup>(1)</sup>	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.

<sup>(1)</sup> **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				Harvest Interval	LERAP Category	Hazard Rating	UK MRL (mg/kg)				
		Broccoli	Brussels Sprouts	Cabbage	Cauliflower				Collards	Broc	B Spr	Cabb	Cauli
dimethoate <sup>(1)</sup>	systemic organo-phosphate. Broad spectrum. Dangerous to a wide range of beneficial insects.	Full	Full	SOLA 0808/06	Full	SOLA 0808/06	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	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	A	Harmful Irritant	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.

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

<sup>(2)</sup> 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)	Full & SOLA 4031/06 (SOLA expires 28/02/07)	Full & SOLA 4031/06 (SOLA expires 28/02/07)	SOLA 0385/05	Full & SOLA 4031/06 14 days SOLA 0385/05 7 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 <sup>(1)</sup>	contact and ingested pyrethroid insecticide.	Full	Full	Full	Full	SOLA 2265/05	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 0739/04	None stated	None stated		None set			
bifenthrin	contact and residual pyrethroid insecticide for control of aphid and whitefly	Full	Full	Full	Full	No Approval	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

<sup>(1)</sup> **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

<sup>(1)</sup> **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

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
copper oxychloride <sup>(1)</sup>	bactericide for control of <i>Xanthomonas</i>	SOLA 0115/01				Pre-planting			None stated	None stated	None set		
fosetyl aluminium <sup>(1)</sup>	systemic phosphonic acid fungicide for control of downy mildew.	SOLA 's Various SOLAs see App. 12				Check SOLA			None stated	Irritant	None set		
propamocarb hydrochloride	translocated, soil/compost applied protectant fungicide for control of damping off and downy mildew.	Full	Full	Full	Full	No Approval	Check product label	None stated	None stated	None set			
tolclofos-methyl	protectant organo-phosphate for control of damping off and wirestem.	SOLA 3527/06	Full	Full	Full	No Approval	None stated	B	Irritant	None set			

#### Notes:

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

<sup>(1)</sup> **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 <sup>(1)</sup>	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** <sup>(1)</sup>	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

<sup>(1)</sup> 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 <sup>(1)</sup>	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 <sup>(1)</sup>	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 <sup>(1)</sup>	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 <sup>(1)</sup>	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  
<sup>(1)</sup> **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 <sup>(1)</sup>	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

<sup>(1)</sup> **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	None stated	None stated	None set				
chlorthal-dimethyl + propachlor	target : residual benzoic and chloroacetamide herbicide mix.	Full	Full	Full	Full	Kale - Full Collards - SOLA 1247/06	None stated	Irritant	None set				
clomazone	target: residual herbicide	SOLA 1031/04	SOLA 1031/04	SOLA 1031/04	SOLA 1031/04	SOLA 1031/04	None stated	Irritant	None set				
clopyralid	target : control of <i>Compositae</i> weeds. Foliar, translocated piclonic.	Full	Full	Full	Full	Various SOLAs see App 12	None stated	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	None	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
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 these appendices 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 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 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

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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
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

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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

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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
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

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

## Appendix 14 Control Points: LEAF & FLOWERHEAD BRASSICAS

### LEAF & FLOWERHEAD BRASSICAS

- CS.58.1 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.58.2 A Nitrogen Prediction System such as WELL - N should be used to calculate crop nitrogen requirement -  
Protocol reference: Section 6.1
- CS.58.3 *Deleted 2004*
- CS.58.4 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.58.5 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.58.6 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.58.7 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