



Assured Produce

Crop Specific Protocol

CUCUMBERS

(CROP ID: 69)



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Acknowledgements

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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 "**must**" (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 "**must**" control points can be found on the final page of this document and in the checklists produced by Assured Produce licensed certification bodies.

Disclaimer and trade mark acknowledgement

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

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

Notes:

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 Products containing substances which have been revoked are shown on the PSD website (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

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

There may be changes for the following reasons:

- At re-registration stage after Annex 1 listing there may be: reductions of dose rates; changes in timings and/or number of applications for some products.

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

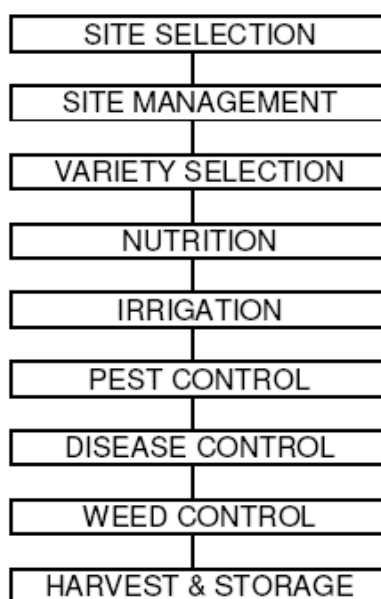
For pesticides on-label, only active substances are shown.

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

1 General introduction

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

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



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

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

2 Planning and records

See Generic Standards and/or Generic Guidance Notes

3 Site selection

See Generic Standards and/or Generic Guidance Notes

4 Site management

See Generic Standards and/or Generic Guidance Notes.

5 Variety selection

See Generic Standards and/or Generic Guidance Notes

Growers should visit their propagators to inspect their plants.

6 Nutrition

See Generic Standards and/or Generic Guidance Notes

Steps should be taken to minimise nitrate levels in applied nutrient solutions. It is strongly recommended that water and nutrients are re-circulated.

If not, steps should be taken to minimise nutrient run-off into soil and water courses.

The volume of run-off should be measured and samples analysed.

7 Irrigation

See Generic Standards and/or Generic Guidance Notes

8 Crop protection

8.1 The basic approach to crop protection

Key principles of ICM for protected salad crops

- a. Biological, environmental and cultural methods of pest and disease control must be used as the first line of defence.
- b. Chemical pesticides are only to be used when biological controls are not available or shown not to be working.
- c. The crops must be monitored at least weekly and records made of pest, disease and biological control organism levels.
- d. Records should be kept of introduction of biological control agents.
- e. Climate control computers should be used to ensure a suitable environment is maintained at all times.
- f. Records must be kept of all pesticide applications

Adaptation for new pests and diseases

The occurrence of a new disease or pest problem is largely unpredictable. It may arise, for example, when a previously non-indigenous disease or pest becomes established in the UK (e.g. WFT), with a change in variety or cropping practice (e.g. switch from soil to substrate cropping) or when a pathogen/pest previously controlled by a particular pesticide develops resistance. In all these situations it may be necessary to implement additional pesticide treatments.

A proposed schedule for controlling 'new' pest or disease problems, in order of priority, is described below.

- a. The key objective is that the organism is controlled by means of a change in glasshouse environment, crop culture, biological or other non-chemical method. In some situations however, it is possible that additional use of pesticides may be necessary, at least in the short term or until a suitable alternate variety with genetic resistance is available. Such new varieties should be incorporated into the cropping programme, as they become available, providing they meet the end-market specifications.
- b. The 'new' pest or disease situation may be controlled by selecting products already known to be

compatible with the biological control measures.

- c. If none of these pesticides provide effective control, advice should be sought on a suitable alternative product, currently approved for use on the appropriate protected crop under Control of Pesticides Regulations (1986).

Training requirements

Pest and disease identification

Staff working regularly on protected crops should be able to recognise the following pests and diseases:

Powdery mildew
Downy mildew
Botrytis (grey mould) on leaves, stems and fruit
Black stem rot (*Didymella* syn. *Mycosphaerella*)
Penicillium stem rot
Pythium root and stem base rot
Various relevant virus diseases:- in particular
Green Mottle Mosaic virus

Beet Psuedo Yellow virus

Melon Necrosis virus

Glasshouse whitefly
Spider mites and other mites
Caterpillar damage
Leaf miner damage
Leaf hopper damage

Thrips

Staff should know who to report to when the above pests and diseases, or other problems regularly found on a particular nursery, are first detected during the season. Managers and supervisors should appreciate the relative risk to their crops from the relevant pests and diseases.

In service training

Training in identification of pests and diseases, their damage and their biological controls and an appreciation of the objectives of this protocol should be given to each new member of staff.

All staff working on the nursery, both regular and casual, should be instructed as necessary to satisfy COSHH requirements with respect to pesticide treatments, and to satisfy the requirements of the General Food Hygiene Regulations.

Monitoring

Regular monitoring of the biological control agents, pests and diseases is of vital importance. It is essential that all crops are walked at least once a week and records kept of each inspection. **All** nursery staff should be alert to fresh pest or disease symptoms or signs of imbalance with biological control mechanisms.

8.2 Plant protection product choice

See Generic Standards and/or Generic Guidance Notes

Approved uses not included on the product label

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

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

In the case of products with older approval an electronic approval may not be available. In these cases growers should contact the PSD Information Services Branch for details of the approved conditions of use. Contact details are: p.s.d.information@psd.defra.gsi.gov.uk tel. 01904 455775.

8.3 Advice on the use of pesticides

See Generic Standards and/or Generic Guidance Notes

8.4 Application of pesticides

See Generic Standards and/or Generic Guidance Notes

8.5 Records of application

See Generic Standards and/or Generic Guidance Notes

8.6 Protective clothing/equipment

See Generic Standards and/or Generic Guidance Notes

8.7 Pesticide storage

See Generic Standards and/or Generic Guidance Notes

8.8 Empty pesticide containers

See Generic Standards and/or Generic Guidance Notes

8.9 Pesticide residues in fresh produce

See Generic Standards and/or Generic Guidance Notes

See Generic • Ensuring all those involved in applying pesticide products are adequately trained 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 earliest applications of fungicides and insecticides to the edible part of the crop to**

reduce residue at time of harvest.

- **Ensuring minimum harvest intervals are followed**
- **Ensuring that application equipment is applying products correctly**
- **Ensuring all those involved in applying pesticide products are adequately trained**

See Appendix 6 for the pesticide targets and guidelines on this crop.

8.10 Cucumber production

8.10.1 Specific hygiene measures

"Old crop" removal

The previous crop must be 'cleaned up' before its removal from the greenhouse as follows:

- a. If two-spotted spider mite and/or broad mite are a problem, they should be treated before they enter diapause with a high volume spray of Dynamec[®], at least twice at five day intervals.
- b. For aphids, fumigate with nicotine as necessary.
- c. It is most important that WFT is controlled during the life of the crop using biological control so that populations do not present a threat in carry-over. Even now with the approval of spinosad it is still important to maintain good control using biological control because this will ensure this product has a long useful life.

At the end of cropping, remove the crop, weeds and all debris and dispose of them in a suitable manner by either removing off site (ensuring the load is covered), or burying on site and spraying the soil surface with a suitable disinfectant.

Where debris is left in a skip awaiting collection, cover it with plastic sheeting. Where plastic sheeting has been used on the floor, roll it up with debris inside and recycle if possible.

Wash down the glass structure inside the glasshouse and then treat with a suitable disinfectant (e.g., gluteraldehyde, peroxyacetic acid, benzoic acid etc). Formaldehyde use is strongly discouraged. Also treat the heating pipes, irrigation lines, drip pegs, hoses and other equipment used in the glasshouse and wipe down crop wires with a disinfectant.

If the crop is grown in an isolated substrate, the substrate should be, where possible, reused for more than one crop. (See Generic Standards 4.4)

Where isolated substrates are reused, they should be sterilised at the end of the season. (See also Generic Standards 4.3 and 4.4)

Sterilise soil or isolated substrates intended for re-use with steam.

Monitor pest activity in the empty glasshouse by using yellow sticky traps. Maintaining glasshouses at 17°C will increase the activity of any remaining pests. Examine the traps regularly for pests and take appropriate action if any are caught:

Repeat the trap monitoring and treatments in the empty glasshouse before replanting, until no further pests are found. A ring can be drawn round low numbers of pests on sticky traps for monitoring purposes, but if large numbers are present, the traps will have to be replaced after each space treatment.

Environment

Destroy all weeds around the glasshouse before the new crop arrives and at regular intervals during the season using non-hormone herbicides of short persistence or by mowing. Several common weeds (eg. chickweed, sowthistle, and dandelion) are known to host cucumber mosaic virus (CMV) and could act as a source of this virus for a Cucumber crop. Weeds may also be means of carry-over of other virus diseases (e.g. TSWV or BPYV). Dandelions can also carry-over powdery mildew from one crop to the next.

New crop establishment

Before the new plants arrive, old sticky traps should be removed. New traps should then be hung in the glasshouse and should be assessed and replaced regularly throughout the life of the crop. Effective monitoring of these traps is an essential element of pest control.

Trays containing the new season's plants must be placed only on a clean surface (eg. new polythene, disinfected and rinsed concrete). For crops grown in rockwool slabs, any previously used slabs should be sterilised with steam and re-used where possible.

Standard of propagated material - Buying in plants

Most nurseries now buy plants in from external propagators. Growers must formalise the supply contract with their propagators, stipulating the pesticides that can be used. Growers should ensure their supplier adheres to their contractual requirements by requesting records of plant treatment and visiting to inspect plants.

When buying in plants, specifications for propagation, including pest and disease control measures, should be given to the propagator. (See Generic Standards 5.1)

For the benefit of both parties, plants should be carefully inspected on delivery and any concerns / complaints notified immediately to the propagator.

***E.coli* and food poisoning**

The risk from food poisoning organisms in this crop are minimal but both the propagator and the grower should be aware of the risks from contamination with animal manures and contaminated water. See generic protocol for further details.

8.10.2 Nutrition and irrigation

Most production areas are now in Nitrate Vulnerable Zones (NVZ) following the changes in designation - growers should be aware of the requirements of any legislation governing use of fertiliser on their nursery.

Where possible, water and nutrients should be recirculated to conserve water and also reduce any possible run-off of nutrients. It is accepted that, at this stage, the recirculation of water for cucumbers is difficult because of virus disease carry-over.

To assist in the correct calculation of irrigation, volume of run off should be measured and samples analysed for nutrient content to ensure the correct quantity of nutrients are applied. (See Generic Standards 7.1)

Irrigation requirement should be closely matched to crop need and steps should be taken to minimise nutrient run off - particularly nitrate and phosphate - into soil and water courses. (See Generic Standards 6.3)

8.10.3 Pest control

Ensure all picking boxes, trolleys, tractor tyres, footwear and any associated tools and equipment are kept thoroughly clean. Treat routinely with an appropriate disinfectant (see Section 8.10.1) and routinely wash clothing and gloves.

Store cleaned boxes and equipment carefully to avoid re-contamination.

After using disinfectants in the glasshouse thoroughly ventilate the house to remove all traces of vapour. Rinse picking trays with water after treating with the disinfectant.

Biological control organisms (BCOs)

The table below lists currently available biological control measures. The rates of introduction should be based on recommendations of the biological control suppliers. The introduction and monitoring of biological control agents must be recorded.

Pest	Control	Notes
Glasshouse whitefly (<i>Trialeurodes vaporariorum</i>)	a) <i>Encarsia formosa</i> b) <i>Amblyseius swirskii</i> c) <i>Verticillium lecanii</i> (Mycotal®) d) Yellow sticky traps	b) may also control other pests c) and d) for corrective action
Sweet potato or tobacco whitefly (<i>Bemisia tabaci</i>)	Statutory control in UK (inform DEFRA's Plant Health and Seeds Inspectorate)	Treatments as for glasshouse whitefly may be permitted by PHSI
Spider mites (<i>Tetranychus urticae</i>)	a) <i>Phytoseiulus persimilis</i> b) <i>Amblyseius andersonii</i> c) <i>Amblyseius californicus</i> d) <i>Feltiella acarisuga</i> e) Eradicote® /Majestic®	b&c) New introduction
Western flower thrips (WFT) or onion thrips (<i>Frankliniella occidentalis</i> or <i>Thrips tabaci</i>)	a) <i>Amblyseius cucumeris</i> b) <i>Amblyseius swirskii</i> c) <i>Orius</i> spp. d) <i>Verticillium lecanii</i> (Vertalec®) e) Eradicote® /Majestic®	a) Standard treatment b) For corrective action c) Difficult to establish
Melon cotton aphid (<i>Aphis gossypii</i>)	a) <i>Aphidius colemani</i> b) Eradicote® /Majestic®	a) Regular introduction required.
Broad mite (<i>Polyphago - tarsonemus latus</i>)	a) <i>Amblyseius cucumeris</i> b) Remove small foci of affected plants	Occasional pest only. Do not introduce biological control agents on leaf material
French 'fly'	Usually only a pest of crops grown on straw bales.	<i>Amblyseius</i> used for WFT will normally give adequate control
Leaf miners	Not usually a pest on Cucumbers, but any leaf miners occurring should be identified correctly. If confirmed as non-indigenous species, statutory control measures will be stipulated by PHSI. Biological control may be permitted	
Leaf Hopper (<i>Hauptidia macroccana</i>)	a) Removal of infested leaves and use of yellow sticky traps are very effective at keeping populations low b) <i>Anagrus atomus</i>	Leaf Hopper infestations are increasing in frequency and it is important to control at an early stage.
Caterpillars	a) Hand picking b) <i>Bacillus thuringiensis</i>	b) Most effective when applied to small larvae

Notes:

The use of the predatory bug *Macrolophus callignosus* is not recommended for Cucumbers because of its effects on other beneficial organisms and the possibility of it causing plant/flower damage.

Chemical control

For some pests biological controls are not available and suitable pesticides are recommended.

Pest	Active ingredient	Notes
Whitefly	a) spiromesifen b) dodecylphenol ethoxylate (Agri 50 E®) c) buprofezin d) fatty acids e) thiacloprid	Double <i>Encarsia</i> introduction for three weeks after any whitefly spray treatment. e) thiacloprid damages biological control when used high volume and this use should be restricted to spot treatments and clean up.
Spider mites	a) spiromesifen b) abamectin	b) Spot treatment only in mature crop.
Aphids (<i>A. gossypii</i>)	a) pymetrozine b) nicotine c) thiacloprid	Use products with a different mode of action to avoid resistance. c) thiacloprid damages biological control and use should be restricted to spot treatments and clean up..
Other aphid species	a) pirimicarb b) pymetrozine c) nicotine	Limited data shows pymetrozine is reasonably safe on biological control agents.
Broad mite	abamectin	As spot spray.
Western flower thrips	spinosad	a) Early treatment needed to prevent thrips damaging fruits. Biological control has to be the first line of control for WFT.
Palm thrips (<i>Thrips palmi</i>)		a) Found in the UK - notify Plant Health if suspicious thrips are found in the crop. <i>Thrips palmi</i> are very similar in appearance to Onion thrips. b) Palm thrips spreads viruses such as Spotted Wilt.
Leaf Hopper	a) indoxacarb b) buprofezin	a) HDC trials have shown useful effects on leaf hopper. b) When used for Whitefly control will give some reduction in Leaf Hopper population.
Caterpillars	a) hand picking b) indoxacarb c) deltamethrin	c) deltamethrin is very persistent and damaging to biological control, only use as an end of season treatment.

8.10.4 Disease control

Certain diseases are relatively common and occur on most holdings each year. The procedure for the control of the common disease problems is given in detail, and the procedure for other diseases is only given in outline. Further technical advice should be sought as necessary.

It cannot be emphasised too strongly that regular crop monitoring with rapid and accurate disease identification and an appropriate rapid response involving roguing of the affected plant, cultural changes, a glasshouse environmental change, or fungicide treatments, is essential to fulfil the objective of minimising fungicide use.

All crops should be walked and inspected for disease at least once every seven days. If a disease is overlooked or seen but no action taken, then several fungicide applications may be required to bring the problem under control, compared with perhaps one or two applications if prompt action is taken.

Botrytis

Preventative action	Spray decision parameter	Fungicide
General		
Control relative humidity (RH). Ensure RH does not rise above 85% for more than a few hours		
Remove debris after trimming		
Allow crop to dry before nightfall after spraying		
On young plants		
Avoid damage at planting	Treat if obvious damage	cyprodinil + fludioxonil, fenhexamid ⁽¹⁾ , chlorothalonil
In the growing crop		
If no <i>Botrytis</i> in the crop and no extended periods of RH >85%	No treatment	
If <i>Botrytis</i> is present in the crop or if RH is >85% for long periods or if <i>Botrytis</i> occurs most years	Check RH records and equipment for accuracy. Preventative spray to stem after trimming	cyprodinil + fludioxonil, fenhexamid, chlorothalonil
	Further sprays immediately after trimming or if RH >85%. Alternate fungicide groups to reduce the risk of resistance	cyprodinil + fludioxonil, fenhexamid, chlorothalonil or iprodione ⁽¹⁾

Notes:

⁽¹⁾ Fenhexamid is not very effective at controlling active *Botrytis*

Apply no more than two applications of either material in any course of treatment and allow as long as possible before further treatment to avoid a build up of resistance. Note that only four treatments of iprodione are allowed per crop and that it may cause fruit marking. Only two applications of chlorothalonil per crop are permitted.

Black stem rot (*Didymella*)

Preventative action	Spray decision parameter	Fungicide
General		
Ensure RH does not rise >85% for more than a few hours - restrict irrigation period to start at least 2 hours after sunrise and end at least 2 hours before sunset		
Remove debris regularly, well away from crop		
Minimise overhead watering where possible		
Remove old crop before re-planting		
On young plants		
Avoid damage at planting	Main risk is in replanted crops; aim at stem base. Alternate fungicide groups to reduce the risk of resistance	cyprodinil + fludioxonil / chlorothalonil / azoxystrobin
On stems, leaves and fruit		
Check RH control		
Allow stems to dry after trimming or preventative spray to stem after trimming	Start spraying programme as soon as disease appears. Repeat every 7-14 days. Preventative spray aimed at stem immediately after trimming	cyprodinil + fludioxonil / chlorothalonil / azoxystrobin

Notes:

Fenarimol applied for mildew gives partial control. Alternate fungicide groups to reduce the risk of resistance

Reduced disease control will occur where resistant isolates are present. Apply no more than two applications

in any course of treatment and allow as long as possible before further treatment to avoid a build up of resistance.

Sprays applied every 7-10 days are more effective than fortnightly sprays, especially when conditions are very humid.

Only two applications of chlorothalonil per crop are permitted.

Powdery mildew

Preventative action	Spray decision parameter	Fungicide
General		
Control humidity but do not over-ventilate, inspect crops regularly, control weeds (esp. sowthistle and dandelion), remove old crop before replanting		
Following initial discovery		
Remove affected leaves (if few) Apply fungicide immediately	Alternate products from different fungicide groups to reduce the risk of resistance	Garlic extracts are effective or use - myclobutanil, imazalil chlorothalonil ⁽¹⁾ , fenarimol, potassium bicarbonate or azoxystrobin ⁽²⁾
Continuing mildew development		
	If mildew continues to increase on young plants	myclobutanil, imazalil fenarimol or azoxystrobin ⁽²⁾
Severe mildew	Seek advice	bupirimate ⁽³⁾

Notes:

Better varieties with tolerance to mildew are now becoming available; most are suitable for later or replanted crops.

⁽¹⁾ Only two applications of chlorothalonil per crop are permitted.

⁽²⁾ Where azoxystrobin is used, it must be used in an integrated control strategy to reduce the build up of resistance. It is best applied before mildew appears to give good protection - once Mildew appears on the crop, azoxystrobin may have little effect. This will mean only one treatment in every three should be using azoxystrobin - use products from different active ingredient groups for the other applications.

⁽³⁾ Do not use bupirimate on young plants; monitor effect.

Pythium

Preventative action	Spray decision parameter	Fungicide
General		
Sterilise soil/use new or sterilised slabs. Stand plants only on clean surfaces. Use mains or borehole water. Avoid cold, wet soil/slabs. Also avoid irrigating with hot water in re-plant period. Leave gap between slabs to prevent movement of <i>Pythium</i> between young plants.		
Precautionary fungicide treatments		
Drench roots and stem base immediately after planting.	Substrate crops	propamocarb hydrochloride ⁽¹⁾ or fosetyl aluminium + propamocarb hydrochloride ⁽¹⁾
Following initial discovery		
Check drainage. Treat adjacent plants.	Substrate crops	propamocarb hydrochloride ⁽¹⁾ or fosetyl aluminium + propamocarb hydrochloride ⁽¹⁾
High incidence of <i>Pythium</i>		
Sterilise soil. Use new slabs. Check hygiene.	Seek advice	

Notes:

⁽¹⁾ maximum of four propamocarb hydrochloride treatments per crop (alone or in mixture)

Less common diseases

Disease	Comment	Action
<i>Phytophthora</i> root rot	Uncommon - mostly found in soil crops	propamocarb hydrochloride ⁽¹⁾ or fosetyl aluminium + propamocarb hydrochloride ⁽¹⁾ Sterilise soil
<i>Rhizoctonia</i> stem base rot	Uncommon - mostly found in soil crops	Sterilise soil. Treat with cyprodinil + fludioxonil spray
Black root rot (<i>Phomopsis</i>)	Can be devastating - mostly found in soil crops but becoming more of a problem in rockwool.	Remove infected slabs, good hygiene at pre-planting - keep soil out of irrigation when fitting laterals / drippers
<i>Sclerotinia</i>	Occasional disease	Remove affected plant parts, chlorothalonil ⁽²⁾⁽³⁾ or iprodione spray. Sterilise soil or use <i>Coniothyrium minitans</i> to soil before planting
<i>Penicillium</i> stem rot	Increasingly common	Remove affected plants. Control humidity. Imazalil spray may have some effect.
Gummosis or scab (<i>Cladosporium cucumerinum</i>)	Rare	Most varieties resistant. Remove affected parts. Control humidity. chlorothalonil ⁽³⁾ spray.
<i>Verticillium</i> wilt	Rare - mostly in soil crops but recently in rockwool	Sterilise soil. Remove affected plants.
<i>Fusarium</i> wilt	Increasing. Mostly in soil crops but recently in rockwool.	cyprodinil + fludioxonil may have some effect on <i>Fusarium</i> . Sterilise soil. Remove affected plants.
Downy mildew	Occasional - can be devastating, spreads very quickly	Check imported plants. Control humidity and keep plants dry. Metalaxyl-M and azoxystrobin are effective.
<i>Alternaria</i> , <i>Stemphylium</i> and <i>Ulocladium</i> leaf spots	Uncommon	Remove affected leaves, control humidity and keep plants dry
Angular leaf spot (<i>Pseudomonas lachrymans</i>)	Rare - occurs at high temps (>24°C)	Keep plants dry

Notes:

- (¹) maximum of four propamocarb hydrochloride treatments per crop (alone or in mixture)
 (²) indicates the least preferred action
 (³) only two applications of chlorothalonil per crop are permitted

Disease	Comment	Action
Cucumber mosaic virus (CMV)	Less common but can be devastating if <i>Pythium</i> is also present	Control aphid vectors. Control weeds
Cucumber green mottle mosaic virus	Occasional - can spread quickly on hands and knives	Use virus free seed. Remove affected plants as soon as they are seen. Thorough hygiene at end of crop. Use of milk on hands and knives helps reduce spread.
Beet pseudo - yellow virus	Increasing in the Lea Valley area - increased risk if whitefly control is inadequate	Control whitefly with early and robust use of <i>Encarsia</i>
Cucumber pale fruit viroid	Rare - no known insect vectors	Remove affected plants
Melon necrotic spot virus	Rare - on rockwool crops - not very damaging - <i>Olpidium</i> vector. Could be risk with recirculation.	Use mains water
Tomato spotted wilt virus	Rare at present	Control thrips and weeds
Tobacco necrosis virus	Rare - on rockwool crops - not very damaging - <i>Olpidium</i> vector. Could be risk with recirculation.	Use mains water
Zucchini yellow mosaic virus	Rare - very distorted fruit	Control aphids

New virus - potential threat to UK crops

A new virus that is similar to Green Mottle Mosaic Virus has been identified in 2002 in the Middle East and Japan. There has also been a report in the UK of a new form of Pale Green Mottle Mosaic Virus. These viruses have the potential to reduce crop yields and fruit quality so any suspicious symptoms should be investigated by appropriate specialists. More details will be made available as and when they are published.

9 Harvesting and storage

See Generic Standards and/or Generic Guidance Notes

To avoid problems with crop contamination and also to reduce any risk of plant diseases being brought into cropped areas, no food should be brought into or consumed in any area where crops are being grown. In most circumstances clearly defined areas should be set aside for eating and drinking. These should be clearly signed. Smoking should also be restricted to non-cropped areas and any designated areas should be clearly signed.

Glasshouses must have appropriate "No Smoking/No Food" signs and that staff are provided with a clearly defined area to eat/drink.

10 Pollution control and waste management

See Generic Standards and/or Generic Guidance Notes

There must be written procedures for the management and recording of incidents involving oil spillages.

11 Energy efficiency

See Generic Standards and/or Generic Guidance Notes

12 Health and Safety

See Generic Standards and/or Generic Guidance Notes

13 Conservation

See Generic Standards and/or Generic Guidance Notes

Appendix 1 Products currently approved for use on protected Cucumbers

Active Ingredient	Trade Name	MAPP Number	Organism Controlled	Approval Type	Expiry	Harvest Interval ⁽¹⁾	Hazard Rating	MRL (mg/kg)
abamectin	Dynamec ® Clayton Abba ® Route One Abamectin 18® Mectinide ®	13331 13808 13560 13953	spider mites	Provisional	31/12/13 31/12/13 31/12/13 31/12/13	3 days	Harmful	0.02*
<i>Bacillus thuringiensis</i>	Dipel WP ®	11184	caterpillar	Provisional	31/08/12	zero	Irritant	none set
bupirimate	Nimrod ®	13046	powdery mildew	Full	31/12/13	2 days	Harmful	1.0 (draft)
buprofezin	Applaud ®	11532	whitefly	Provisional	30/03/10	3 days	none stated	1.0 (draft)
chlorothalonil	Repulse ® (various alternative materials)	Various	<i>Botrytis</i>	Full	31/12/13	2 days	Harmful	1.0
<i>Coniothyrium minitans</i>	Contans® WG	12616	<i>Sclerotinia</i>	Not classified	31/12/13	zero	Harmful	none set
copper ammonium carbonate	Croptex Fungex ®	11049	Mildew	Full	31/12/13	zero	Harmful	5.0 (draft)
deltamethrin	Decis ® (various alternative materials)	Various	aphids, caterpillar	Full	31/12/13	zero	Harmful	0.2
dodecylphenol ethoxylate	Agri 50 E ®	00000	whitefly	Not classified	none stated	zero	Harmful	none set
fatty acids	Savona ® Saifers Insecticidal Soap ®	06057 07197	Pests	Full	31/12/13 31/12/13	zero	Flammable	none set

Notes:

(1) or latest time of application

Always read the product label before use - full details of application rates and harvest intervals will be found there.

Appendix 1 Products currently approved for use on protected Cucumbers (cont'd)

Active Ingredient	Trade Name	MAPP number	Organism Controlled	Approval Type	Expiry	Harvest Interval (1)	Hazard Rating	MRL (mg/kg)
ferric phosphate	Ferramol ®	12274	slugs & snails	Not classified	10/2013	none stated	none stated	none set
garlic juice	Garlic Barrier AG ®	00000	pests	Not classified	none stated	none stated	none stated	none set
glucose polymer	Eradicoat ®, Majestic	00000	pests	Not classified	none stated	zero	Irritant	none set
fosetyl-aluminium + propamocarb hydrochloride	Previcur Energy ®	13342	Pythium, Phytophthora	Full	31/12/13	3 days	none stated	75 (draft) 10 (draft)
imazalil	Fungafloor 100 EC ® Imaz 200 EC ®	12978 12991	powdery mildew	Not stipulated	30/06/10 31/12/11	3 days	Harmful	0.2
indoxacarb	Steward ®	13149	caterpillars	Full	31/03/16	1 day	Harmful	0.2
metaldelhyde	Various	Various	slugs & snails	Not classified	12/2013	none stated	dangerous to birds & animals	none set
nicotine	Nicotine 40% Shreds ®	05725	pests	Full	08/06/10	1 day	Harmful	none set
nicotine	No-Fid ® (various alternative materials)	Various	pests	Full	08/06/10	2 days	Risk to bees	none set
pirimicarb	Aphox ® (various alternative materials)	Various	aphids	Full	31/12/13	2 days	Toxic Harmful	1.0 (draft)
pirimiphos methyl	Fumite Pirimiphos Methyl Smoke ®	00941	pests	Full	30/09/09	zero	Harmful	0.1
propamocarb hydrochloride	Fiflex ® (various alternative materials)	Various	Pythium, Phytophthora	Full	31/12/13	14 days (soil)	none stated	10 (draft)
pymetrozine	Chess WG ®	10651 13310	aphids (capsids)	Provisional	31/07/08 30/10/11	3 days	Risk to bees	0.5
pyrethrum	Pyrethrum 5EC ® Spruzit ®	12685 13438	pests	Not classified	31/12/13 31/12/13	zero	Environmental hazard	none set
spinosad	Conserve ®	12058	WFT, caterpillar	Provisional	31/01/17	3 days	Environmental hazard	1.0 (draft)
<i>Verticillium lecanii</i>	Mycotal ®, Vertalec ®	04782 04781	pests	Full	31/12/13	zero	none stated	none set

Notes:

(1) or latest time of application

Always read the product label before use - full details of application rates and harvest intervals will be found there.

Appendix 2 Insecticide compatibility with Biological Control Organisms

Product	<i>Phytoseiulus</i>		<i>Encarsia</i>		<i>Aphidius</i>		<i>Amblyseius</i>
	Eggs	Adults	Pupae	Adults	Mummy	Adult	
abamectin	S	H (<21)	S	H (<21)	-	H (7)	H (<21)
buprofezin	S	S	I (<4)	S	S	S	S
fatty acids	I	H (I?)	S	H (I?)	-	H (I?)	H (I?)
fenbutatin oxide	S	S	S	S	S	S	S
nicotine (spray)	-	H (<7)	S	H (<4)	-	H	H
nicotine (smoke)	S	S?	S	H	-	H	I (?)
pirimicarb	S	S	S	H (1)			H (3)
pymetrozine	S	S	S	S	S	I (3)	S
thripstick [®]	S	S	S	S	S	S	S

Notes:

Key:

S : Safe

I : Intermediate

H : Harmful

() : Number = No of days

- : Not tested; assume harmful unless evidence to the contrary

? : Not tested but suspected from practical experience

This table is based on the latest information. With certain formulations and under certain circumstances the selectivity above will be affected, therefore, always refer to the supplier of biological control organism.

Appendix 3 Fungicide compatibility with Biological Control Organisms

Product	<i>Phytoseiulus</i>		<i>Encarsia</i>		<i>Aphidius</i>		<i>Amblyseius</i>
	Egg	Adult	Pupae	Adult	Mummy	Adult	
azoxystrobin	-	S	S	S	S	S	S
bupirimate	S	I	S	S	-	S	I
chlorothalonil	S	S	S	S	-	S	I
fenarimol	S	I	S	S	-	S	S
imazalil	H	S	S	S	-	S	S
iprodione	S	S	I	S	S	S	S
propamocarb hydrochloride	S	S	S	S	S	S	S

Notes:**Key:**

S : Safe

I : Intermediate

H : Harmful

- : No information; assume harmful unless evidence to the contrary

This is a guide based on the latest available information, but under certain circumstances or with certain formulations the above may not be true. Refer to the supplier of control organisms.

Appendix 4 Specific off-label approvals (SOLAs) for use on protected Cucumbers

Active Ingredient	Trade Names	MAPP number	Organism Controlled	SOLA Number	Expiry	Harvest Interval ⁽¹⁾	Hazard Rating	MRL (mg/kg)
azoxystrobin	Amistar [®]	10443	diseases	1685/01 1533/02	31/12/11	3 days	Environmental Hazard	1.0
cyprodinil + fludioxonil	Switch	13158	<i>Botrytis, Mycosphaerella, Fusarium</i>	0234/07	31/12/13	3 days	Environmental Hazard	0.5 (draft) 1.0 (draft)
<i>Bacillus subtilis</i>	Serenade ASO [®]	14318	<i>Botrytis</i>	0246/09	25/11/12	zero		none set
deltamethrin	Decis [®]	07172	pests	1693/07	31/12/13	zero	Harmful	0.2
deltamethrin	Bandu [®]	10994	pests	1611/07	31/12/13	zero	Harmful	0.2
deltamethrin	Cleancrop Decathlon [®]	12834	pests	1633/07	31/12/13	zero	Harmful	0.2
deltamethrin	Decis Protech [®]	11502	pests	1650/07	31/12/13	zero	Harmful	0.2
fenarimol	Rubigan [®]	12355	Powdery Mildew	3125/07	30/06/09	3 days	Harmful	0.2
fenhexamid	Teldor [®] Agrovista Fenamid [®]	11229	<i>Botrytis</i>	2085/04 0480/08	30/11/10 31/05/11	1 day	Environmental Hazard	1.0
metalaxyl M	SL 567 A [®]	12380	Downy Mildew	1503/05	30/09/12	2 days	Harmful	0.5
myclobutanil	Systhane 20 EW [®]	09396	Powdery Mildew	0627/07	31/12/13	3 days	Environmental Hazard	0.1
propamocarb hydrochloride	Proplant [®]	08572	<i>Pythium, Phytophthora</i>	3424/07	30/09/09	2 days	none stated	10 (draft)
propamocarb hydrochloride	Proplant [®]	13359	<i>Pythium, Phytophthora</i>	2945/07	31/12/13	2 days	none stated	10 (draft)
propamocarb hydrochloride	Filex [®]	07631	<i>Pythium, Phytophthora</i>	2032/99	31/12/13	2 days	none stated	10 (draft)
spiromesifen	Oberon [®]	11819	RSM and whitefly	0958/05	30/04/13	3 days	Irritant	0.3
sulphur	Thiovit Jet [®]	10928	powdery mildew	3652/02	31/12/13	zero	Irritant	50 ⁽²⁾
sulphur	Microthiol Special [®]	06268	powdery mildew	2024/07	31/12/13	zero	Irritant	50 ⁽²⁾
sulphur	Solfa WG [®]	11602	powdery mildew	2239/07	30/12/13	zero	Irritant	50 ⁽²⁾
teflubenzuron	Nemolt [®]	10226	pests	2119/07	31/12/13	3 days	Toxic	0.5 (draft)
thiacloprid	Calypso [®] Agrovista Reggae [®]	11257	aphids, whitefly etc	3728/06 0474/08	31/12/14 31/12/14	3 days	Harmful	0.3

Notes:

(1) or latest time of application

(2) MRL for sulphur is in negotiation to be removed altogether because of confusion between naturally occurring sulphur and that applied as a pesticide.

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

Specific off-label uses may only take place if all the conditions given 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 that would otherwise apply.

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

Appendix 5 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
azoxystrobin	Powdery mildew, <i>Mycosphaerella</i> etc	Residue found occasionally just above limit of determination but well below MRL	Use alternative materials where available.
carbendazim		Withdrawn from use on cucumber - alternative products being sought	
dithiocarbamate	Seedling disease	Residue found occasionally just below the limit of determination but well below MRL	Assumed to be contamination of fruit from rubber gloves. Do not use rubber gloves when handling fruit.
propamocarb hydrochloride	<i>Pythium</i>	Residue found occasionally above limit of determination but below MRL	No alternatives available. Use at lowest effective rate.
		No other active ingredients causing residue problems.	

1. Pesticide use on UK cucumbers is low
2. There are no organochlorine insecticides approved for use on UK cucumber crops nor any herbicides, plant growth regulators or post harvest treatments. No organophosphates should be necessary and the only remaining OP will be removed this year.
3. There are no official records of any pesticide residues being above MRLs or of non-approved pesticides in UK-grown Cucumbers in recent years, so current approaches are achieving good results.
4. Integrated Crop Management strategies for pest and disease control should continue to be the key approach to be used, with emphasis on non-pesticide strategies.
5. Virtually all UK commercial cucumber crops are grown in heated glasshouses. This affords the opportunity for effective deployment of biological pest control and the prevention of disease infection by environmental manipulation.
6. Those pests and diseases for which pesticide intervention is still most likely to be required in the UK are WFT, spider mites, powdery mildew, *Mycosphaerella* and *Botrytis*.
7. The acceptance of materials for pest control through a physical mode of action as not being pesticides, and therefore not having to comply with pesticide legislation or having residue problems, should be considered. Examples are plant extracts of garlic¹, glucose polymers² and polysaccharides³ e.g. Garshield¹, Ecospray¹, Eradicoat², Majestik² and Agri-50E³ respectively.

Recommendations for minimising residues

Generic recommendations

1. Avoid pesticide use by:

- good husbandry, including irrigation and nutrition.
- good site hygiene.
- use of clean plant material and powdery mildew resistant cultivars.
- use of biocontrol agents for pest control, and when available, disease control.
- use of environmental manipulation.
- use of spray materials with physical modes of action (non-pesticides) where appropriate

2. Minimise pesticide use by:

Maintaining strict routines of crop monitoring to ensure that any remedial action is taken at the first opportunity for greatest effect with least sprays.

Ensuring adequate training in the recognition of pests, diseases and biocontrol agents by all staff, especially crop workers, to ensure rapid and appropriate response.

Ensuring adequate training in glasshouse environment control, for disease suppression especially.

Maintaining and calibrating boom sprayers with care to ensure efficient spray application.

Ensuring correct dose rate as this may vary according to the target pest and whether on or off label.

Choosing any pesticides with careful attention to possible side effects on biocontrol agents.

Crop specific recommendations for cucumbers

Techniques which may be used for other crops, such as increasing harvest intervals, are not generally relevant to cucumbers once harvesting has commenced since this lasts for many weeks and is carried out daily in some periods. All crops are multiple cropped usually re-planted at least once and more often twice per season

Appendix 6 Control Points: Cucumbers

CS.69 CUCUMBERS

- CS.69.2 Water and nutrients should be re-circulated if possible
 - Protocol reference: Section 6
- CS.69.3 Steps should be taken to minimise nutrient run-off into soil and water courses
 - Protocol reference: Section 6
- CS.69.4 The volume of run-off should be measured and samples analysed
 - Protocol reference: Section 6
- CS.69.5 Steps should be taken to minimise nitrate levels in applied nutrient solutions
 - Protocol reference: Section 6
- CS.69.6 You should visit the propagator to inspect your plants
 - Protocol reference: Section. 5
- CS.69.7 You must have written procedures for the management and recording of incidents involving oil spillages
 - Protocol reference: Section 10
- CS.69.8 Glasshouses must have appropriate "No Smoking/No Food" signs and your staff provided with a clearly defined area to eat / drink
 - Protocol reference: Section 9
- CS.69.9 The introduction and monitoring of biological control agents must be recorded
 - Protocol reference: Section 8.10.3