



AGRICULTURE AND NATURAL RESOURCES DIVISION

Plant Protection Guide for Covered Production

All crops

Revised January 2015

Introduction

This guide is written to assist farmers using covered production, growing crops in polytunnels. The approach taken is that of prevention and the early detection of pests and diseases to avoid a build up to a damaging level. The aim is to minimise the use of chemical pesticides. This is in the interests of the end consumer of the produce, to reduce the development of pesticide resistance, to protect the environment and last but by no means least, to cut down on costs. Biopesticides (non-chemical pesticides based on natural enemies) and natural enemies are promoted as much as possible.

The guide is applicable to all crops commonly grown under covered production, with specific attention to the pests which affect tomatoes and cucumbers.

The guide has four parts:

- Section 1 gives some general guidelines on scouting, hygiene, plant protection and record keeping.
- Section 2 gives information on specific information on target pests and diseases, giving signs to look out for, which crops are affected, and how to prevent and treat them, for: fungal diseases, bacterial diseases, insect pests, and mites.
- Section 3 provides guidance on the pesticides available for the protection of crops grown under covered production, and specifically tomatoes and cucumbers. Refer to the label for application and harvest interval details for other crops.
 - The first template is for the growing plant up to first flowering, and the second for the period of crop production, from first flowering.
 - A template is also given showing the products available from the ANRD spraying service, plus a table showing which ANRD products can be tank-mixed together, to help covered production farmers plan their spraying regimes if they chose to use the ANRD service.
- Section 4 gives details of where to find further information and technical support.

We hope that it is useful and welcome all comments and suggestions for improvements.

1. Some general guidelines

Scouting:

- Check the crop daily if possible. Walk along each row looking at the top and bottom of leaves and the stem.
- There seem to be more pests and disease on the plants in the outer rows and less in the inner.
- Look for holes in leaves and fruit, leaves with paler speckles, insects flying around, insect droppings, leaves browned and drooping.

Hygiene:

- Clean away the weeds in and around the tunnels, they can harbour pests.
- Use a different protective coat or overall for each tunnel, keep it on a peg inside the door. That way you avoid carrying pests from tunnel to tunnel.

Plant protection:

- Pick off any caterpillars and brown, drooping leaves and take them away for burning, to stop infestations arising and avoid spreading it to other tunnels. Never leave infested leaves in the tunnel, you are just breeding problems.
- Harvest the crop before you use any pesticide.
- Use as little pesticide as possible. This saves you money, protects the pesticide sprayer, the consumer of the crop and also the environment, and also reduces the chances of pesticide resistance developing so that sprays will continue to work when you really need them.
- If there is a choice, use a biopesticide instead of a chemical one. This protects natural enemies such as those helping to keep whitefly down.
- Always read the pesticide label carefully.

Records:

- Keep records of all the sprays you use in the tunnel.
- It is also advisable to keep records of night and day temperatures. Temperature will affect the incidence of pests and diseases, as well as affecting fertilizer up-take by plants. Healthy plants are better at keeping off pests and diseases as well as giving a better harvest.

The guidelines given here are based on a regime of frequent crop inspections and action taken against pests and diseases as required, using pesticides compatible with the natural enemies which already occur in tunnels.

2. Specific information on target pests and diseases

Fungal diseases

Early blight



There are two types of blight, Early and Late, and they are caused by different kinds of fungus.

Early blight is caused by the fungus *Alternaria solani*. It is typical of warmer, tropical countries and is the commonest form of blight in St Helena, and also the form encountered in polytunnels. Late blight is caused by the fungus *Phytophthora infestans*. It is a much more serious disease, being more severe and quick spreading than Early blight, but is rare on St Helena.

Fungi reproduce by spores which can survive in the soil and in plant residues such as stems of potatoes and related plants such as tomatoes and egg plants. Blight can spread from plant to plant by irrigation water splash or on the cloths of workers in the tunnels.

Signs to look out for:

- Brown spots on the lower leaves, underside of leaf is green. The spots typically show a pattern of concentric circles.

Affects:

- Mainly tomatoes, also possibly aubergine and peppers.

Management:

Early blight is one of the few problems it is cost-effective to do preventative spraying for in the hot dry season when it is most prevalent, from week 2 after transplant. Otherwise, treat with a fungicide such as Bravo 720 (active ingredient chlorothalonil) as soon as symptoms are seen: spray at 7 to 14 day intervals.

Powdery mildew



Powdery mildew is a fungus (*Podosphaera fusca*) which attacks the large, soft leaves of cucumbers, pumpkins and related plants, turning them white. It is encouraged by dry soil and moist conditions, such as are found in polytunnels on plants fed by drip irrigation.

Signs to look out for:

- White powdery patches on the lower leaves.

Affects:

- Cucumbers, pumpkin and squash.

Management:

A preventative treatment of milk can be used (milk has strong anti-fungal properties), from week 2 after transplant for tomatoes, and first true leaf for cucumbers:

- Milk: spray 10% of any milk (skimmed, semi-skimmed or full cream) at 5 day intervals.

If powdery mildew appears later on there is no locally available pesticide which is registered for it. Note that powdery mildew is a completely different problem to downy mildew which doesn't occur on St Helena and yet is common in South Africa. A product listed for downy mildew won't be effective against powdery mildew.

The ANRD spraying service has an effective product, Nimrod (active ingredient bupirimate), and can be called in: applied at 14 day intervals, with a maximum of 6 sprays per crop.

Bacterial diseases

Bacterial wilt



Also known as Southern Bacterial Wilt, this is caused by the bacteria *Pseudomonas solanacearum*. It is most prevalent at high temperatures.

Signs to look out for:

- Entire plant wilts and dies very rapidly, starting at the top of a single stem. Leaves remain green.
- Check by part-filling a jar with water and suspending the cut stem in the water. Within a few minutes (heavy infection) or hours (light infection) you will see strings of milky slime oozing from the stem and hanging in the water.

Affects:

- Mainly tomatoes, also possibly aubergine and peppers.

Management:

There is no treatment. Crop rotation is important to keep infection down, don't follow a crop of susceptible crops with another. Bacteria can survive indefinitely in the soil, so avoid planting a susceptible crop for at least 4 years in the same ground if bacterial wilt is a problem. Remove infected plants and the soil around their roots.

The following have been recorded as helping reduce the incidence of bacterial wilt:

- Application of sawdust or peatmoss
- Application of nitrite form of fertilizers
- Raise soil pH to 7.5-7.6 and increase available calcium by adding lime.

Insect pests

Aphids



There are a number of different species of aphid on St Helena, each one preferring a different group of crops, and varying colours, mostly shades of green. The commonest ones attacking covered production crops are *Myzus persicae* and *Aphis gossypii*.

Signs to look out for:

- In cucumbers leaves are pinched and curled (left photo); small dark or green insects clustered underneath (right photo).
- Small dark or green insects on the lower stem, underside of leaves and scattered around the plant, a few with wings but mostly without.

Affects:

- Aubergine, beans, cucumbers, peppers, tomatoes

Management:

Treat when insects are first seen:

- A systemic insecticide such as Aphicide (active ingredient dimethoate): spray at 14 day intervals for up to 3 sprays per crop.

Caterpillars



There are four types of caterpillar which attack crops, two green ones (two kinds of looper, *Trichoplusia ni* and *Ctenoplusia vittata*) and two which can be either green or brown (the army worm *Spodoptera littoralis* shown in the photos above and the bollworm *Helicoverpa zea*). Signs to look out for and management are the same, so they are treated collectively here.

Signs to look out for:

- Holes in leaves and fruit, “windows” in leaves between the veins, dark round droppings on leaves.

Affects:

- All crops: aubergine, beans, cucumbers, lettuce, peppers, tomatoes

Management:

Treat when caterpillars are first seen:

- If infestation is localised nip off all the caterpillars seen, both large and small, and either squash or drown them.
- If infestation is widespread use a general insecticide such as Garden Ripcord (active ingredient cypermethrin): spray at 7 to 14 day intervals as required; one treatment is usually enough to control an infestation.

The ANRD spraying service can also apply a biopesticide, Dipel (active ingredient *Bacillus thuringiensis*), which is effective against young caterpillars at an early stage of infestation, but not so good with older ones. Dipel is compatible with effective whitefly management as Garden Ripcord can kill the wasp *Encarsia* which controls whitefly grubs(see below, under whitefly).

Crickets



Crickets (*Gryllus bimaculatus*) can be very common in polytunnels as they like the warm, dry conditions. They have small weak jaws which can only damage young plants or relatively soft leaves.

Signs to look out for:

- Large irregular shaped holes in leaves, at the edge or in the middle, dark wet droppings on leaves.
- Young seedlings attacked at night, stems and leaves bitten through above ground.

Affects:

- All crops: aubergine, beans, cucumbers, lettuce, peppers, tomatoes

Management:

Crickets harbour in cracks in the soil, under or around the plant bag or pot. Treat only if holes are extensive, or young vulnerable plants when the cricket population is high:

- Drench or dust the ground around the plants with a general insecticide such as Garden Ripcord (active ingredient cypermethrin): spray at 7 to 14 day intervals; one treatment is usually enough to control an infestation.

Root mealybug



The root mealybug (*Rhizoecus* sp.) isn't common and can be overlooked as early infestations are found on the roots and lower stems which can be hidden by the lower leaves. Later infestations creep up the stem progressively, and advanced infestations can be found on stems high up the plant.

Signs to look out for:

- White cottony bugs around the base of the plant, down into the root mass.
- In heavier infestations bugs advance up the stem.

Affects:

- Aubergine, beans, cucumbers, peppers, tomatoes

Management:

Treat when insects are first seen:

- Spot treat the infected part of plant and root mass with a product such as Malathion 50% EC (active ingredient mercaptothion).

Thrip



Thrip are tiny insects which are hard to spot unless you are specifically looking for them. On cucumbers, the curled fruit they cause is often the first sign of their presence.

Signs to look out for:

- Small long thin insects on the flowers and leaves (arrowed in the photo above); curled fruit in cucumbers.

Affects:

- Aubergine, beans, cucumbers, peppers, tomatoes

Management:

For prevention, the ANRD spraying service can apply two alternative biopesticides which reduce thrip and keep numbers low:

- Mycotal (active ingredient *Lecanicillium muscarium*): applied every 7 days. Note that it can take 7 days for insects to die.
- Naturalis-L (active ingredient *Beauveria bassiana*): applied at 7 day intervals, up to 5 sprays per crop.

Once thrip are seen, or if they persist despite preventative spraying, a chemical spray can be used. Use a different product each season:

- Malathion 50% EC (active ingredient mercaptothion): spray at 7 day intervals.
- Dynamec (active ingredient abamectin): spray at 7 day intervals, maximum of 6 sprays per crop, 2 for pre-flowering plants and 4 for flowering and fruiting plants.

Whitefly



Whitefly *Trialeurodes vaporariorum* are very prevalent in the hotter summer months. The adult females lay eggs on the underside of young plants, so adults and eggs can be found on the upper leaves, young grubs on lower leaves, and older grubs on the bottommost leaves.

Signs to look out for:

- Early infestation - adult white flies on the upper leaves of plants (left photo)
- Heavy infestation – adults on upper leaves, lower leaves underside covered with green pupae (right photo).

Affects:

- Aubergine, beans, cucumbers, peppers, tomatoes

Management:

Whitefly are very difficult to control as most are resistant to many pesticides, including Garden Ripcord and Malathion. A natural enemy exists, a tiny parasitic wasp called *Encarsia formosa*, it can be seen as small black dots among the green dots of whitefly larvae; both can be seen on the right photo, above. Minimising pesticide use and choosing biopesticides helps *Encarsia* survive and spread.

ANRD applies a strategy of combining knock-down of adult whitefly with a product, Oberon (active ingredient spiromesifen), together with introduction of the parasitic wasp *Encarsia* to give long-term control of the whitefly grubs.

The product Mulan (active ingredient acetamiprid) has also proved successful at knocking down adult whitefly and is available from South Africa.

In 2015 the Biocontrol Unit at ANRD will be breeding *Encarsia* wasps specifically for polytunnel farmers; in the meantime more limited numbers can be supplied on request.

The ANRD spraying service can also apply two alternative biopesticides which reduce whitefly and keep numbers low:

- Mycotal (active ingredient *Lecanicillium muscarium*): applied every 7 days. Note that it can take 7 days for insects to die.
- Naturalis-L (active ingredient *Beauveria bassiana*): applied at 7 day intervals, up to 5 sprays per crop.

Many farmers have success applying a spray of soapy water every 3 days, once the first signs of whitefly are seen.

Yellow sticky traps will help keep adult whitefly numbers low, place 1 trap every 5m, hung at the height of the top of the plants.

Mites

Red spider mite



The red spider mite *Tetranychus urticae* is most prevalent in the hotter summer months.

Signs to look out for:

- Pale speckling on the upper surface of leaves, small dark red dots and light webbing on the underside.

Affects:

- Aubergine, beans, cucumbers, peppers, tomatoes

Management:

Treat when mites are first seen:

- Dynamec (active ingredient abamectin): spray at 7 day intervals, maximum of 6 sprays per crop, 2 at the pre-flowering stage and 4 for flowering and fruiting plants.

If mites recur at a later stage of the crop when the maximum number of Dynamec applications has already been applied, call in the ANRD spraying service which has other products with different modes of action.

Rust mite



The rust mite *Aculops lycopersica* can be devastating with potentially 100% loss of plants. Rust mites like hot, dry conditions and so attack during the summer months.

The main objective of regular scouting is to spot early signs of rust mite as preventative spraying isn't possible (mites are difficult to kill and so the pesticides which control them are powerful and can only be applied a certain number of times to each crop). Rust mites are easily spread on the clothing of workers, by winged insects such as whitefly and aphids, or by wind. Die-off can be very quick so plants need to be treated as soon as symptoms are seen.

Signs to look out for:

- Bronzing of lower leaves, browning and curling of dried leaf edges, sometimes brown dust-like symptoms can be seen along the leaf margins; these are the mite bodies so you need to be careful to avoid spreading them around the crop.

Affects:

- Tomatoes

Management:

Treat as soon as symptoms are first seen:

- Dynamec (active ingredient abamectin): spray at 7 day intervals, maximum of 6 sprays per crop, 2 at the pre-flowering stage and 4 for flowering and fruiting plants.

If mites recur at a later stage of the crop when the maximum number of Dynamec applications has already been applied, the ANRD spraying service has other products with different modes of action.

3. Pesticide and spraying guide

Plant protection template for tomatoes and cucumbers

Growing phase of plant, from transplant to first flowering and fruiting

Pest / disease	Product trade name	Active ingredient	Resistance code*	Details
Prevention				
Powdery mildew	Milk	Milk proteins	Not applicable	Spray every 5 days
Treatment if seen				
Aphids	Aphicide	Dimethoate	1B	Spray every 14 days up to 3 treatments
Caterpillar	Garden Ripcord	Cypermethrin	3A	Spray at 7 to 14 day intervals
Root mealybug	Malathion	Mercaptothion	1B	Spray at 7 to 10 day intervals
Thrip	Malathion Dynamec	Mercaptothion Abamectin	1B	Spray at 7 to 10 day intervals Spray every 7 days up to 4 treatments
White fly	Soapy water	Fatty acids	Not applicable	Spray every 3 days
Red spider mite	Dynamec	Abamectin	1B	Spray every 7 days up to 4 treatments
Rust mite	Dynamec	Abamectin	1B	Spray every 7 days up to 4 treatments

*Pesticides are given codes depending on their mode of action. Resistance management is about alternating products with different codes.

Early to late fruiting phase of plant

Pest / disease	Product trade name	Active ingredient	Resistance code*	Details	Harvest interval
Prevention					
Powdery mildew	Milk	Milk proteins	Not applicable	Spray every 5 days	No harvest interval
Treatment if seen					
Blight	Bravo	Chlorothalonil	M3	Spray at 7 to 14 day intervals.	3 days
Powdery mildew				Call ANRD for an application of Nimrod	2 days
Aphids	Aphicide	Dimethoate	1B	Spray every 14 days up to 3 treatments	14 days
Caterpillar	Garden Ripcord	Cypermethrin	3A	Spray at 7 to 14 day intervals	4 days
Root mealybug	Malathion 50% EC	Mercaptothion	1B	Spot treat at 7 – 10 day intervals	Tomatoes: 1 day Other crops: 4 days
Thrip	Malathion	Mercaptothion	1B	Spray at 7 to 10 day intervals	Tomatoes: 1 day Other crops: 4 days
	Dynamec	Abamectin	6	Spray every 7 days up to 4 treatments	3 days
White fly	Soapy water		Not applicable	Spray every 3 days For a chemical product or biocontrol, call ANRD	No harvest interval
Red spider mite	Dynamec	Abamectin	6	Spray every 7 days up to 4 treatments	3 days
Rust mite	Dynamec	Abamectin	6	Spray every 7 days up to 4 treatments	3 days

*Pesticides are given codes depending on their mode of action. Resistance management is about alternating products with different codes.

Tank mixing two or more products to apply at the same time can damage the plant or be ineffective if the products aren't compatible. Consult the label for compatibility, or contact ANRD for advice.

Pesticides available through the ANRD spraying service

Pest / disease	Product trade name	Active ingredient	Resistance code*	Details	Harvest interval
Whitefly, thrip and spider mite	Mycotal	<i>Lecanicillium muscarium</i>	Not given	Do not tank-mix with other products	0
Whitefly, thrip and spider mite	Naturalis-L	<i>Beauveria bassiana</i>	Not given	Up to 5 sprays per crop. Do not tank-mix with other products	0
Caterpillars (young stages)	Dipel	<i>Bacillus thuringiensis</i>	11	Can mix with Dynamec and broadly compatible with other products	0
Caterpillars	Supasect	Cypermethrin	3A	Up to 2 sprays per crop. Believed to be generally compatible	3 days
Aphids, red spider mite, thrip	Danadim Progress	Dimethoate	1B	Up to 3 sprays per crop. Can mix with Odeon	1 day (cucs) 7 days (toms)
Mites, thrip	Dynamec	Abamectin	6	6 sprays per crop (4 for flowering or fruiting). Do not use with stickers or wetting agents. Can mix with Nimrod and Sanlaxyl	3 days
Mites	Borneo	Etoxazole	10B	1 spray per crop. Believed to be generally compatible	3 days
Mites	Oberon	Spiromesifen	23	2 sprays per crop. Believed to be generally compatible	3 days
Root mealybug	Malathion	Malathion	1B	Used for spot treatment only	4 days
Blight	Sanlaxyl	Mancozeb + metalaxyl	M3 + Group A: 4	Can mix with Odeon and Dynamec	7 days
Blight	Odeon	Chlorothalonil	M5	Believed to be generally compatible	3 days
Powdery mildew	Nimrod	Bupirimate	Group A: 8	Can mix with Danadim, Dynamec, Sanlaxyl and Odeon	2 days

*Pesticides are given codes depending on their mode of action. Resistance management is about alternating products with different codes.

ANRD products: tank mixes – what can be sprayed with what

	Mycotal	Naturalis	Danadim	Dynamec	Borneo/ Oberon	Sanlaxyl	Odeon/ Bravo	Nimrod
Dipel	No	No	Yes	Yes	Yes	Yes	Yes?	No
Mycotal		-	No	No	No	Yes-3 days apart	No	Yes –1 day apart
Naturalis			No	No	No	No	No	No
Danadim				Yes?	Yes?	Yes?	Yes?	Yes
Dynamec					-	Yes	Yes?	Yes
Borneo/ Oberon						Yes?	Yes?	Yes?
Sanlaxyl							-	Yes
Odeon/ Bravo								Yes

Equivalent products to those used by the ANRD spraying service

The table below gives the products available locally which are equivalent to those available through the ANRD spraying service. In some cases the active ingredient is the same and the products are more or less identical, while in others ANRD can offer a better, professional grade product, or alternative active ingredient for resistance management.

ANRD product	Pest or disease	Locally available product
Dipel (<i>Bacillus thuringiensis</i>)	Caterpillars	No biopesticides available
Mycotal (<i>Lecanicillium muscarium</i>)	Whitefly, thrip, spider mite	No biopesticides available
Naturalis-L (<i>Beauveria bassiana</i>)	Whitefly, thrip, spider mite	No biopesticides available
Supasect (cypermethrin)	Caterpillars	Garden Ripcord (cypermethrin)
Danadim Progress (dimethoate)	Aphids	Aphicide (dimethoate)
Dynamec (abamectin)	Mites, thrip	Dynamec (abamectin)
Borneo (etoxazole)	Mites	Dynamec (abamectin)
Oberon (spiromesifen)	Mites	Dynamec (abamectin)
Malathion (mercaptotion)	Root mealybug	Malathion or Malasol (mercaptotion)
Sanlaxyl (mancozeb+metalaxyl)	Early blight	Bravo (chlorothalonil)
Odeon (chlorothalonil)	Early blight	Bravo (chlorothalonil)
Nimrod (bupirimate)	Powdery mildew	Nothing available

4. Support and advice

ANRD can provide technical advice and support to assist you in identifying pests and other problems on your crops, checking soil pH, and also offers a complete professional spraying service. Call Pest Control or Farmer Support on 24724.

There is a wealth of information available on the internet. Some useful websites are:

- ANRD IPM webpage: <http://www.sainthelena.gov.sh/integrated-pest-management/>
- Atlas of plant diseases <http://www.atlasplantpathogenicbacteria.it/index.htm>
- IPM Online (University of California): <http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html>
- Plantwise Knowledge Bank: <http://www.plantwise.org/KnowledgeBank/Home.aspx>
- Pests of Field Crops in Southern Africa: <http://www.pestsandcrops.com/index.htm>