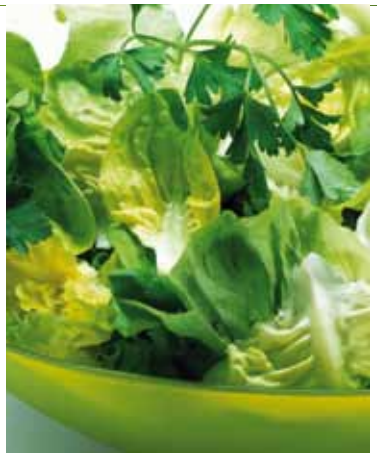
PIP



GUIDE TO GOOD CROP PROTECTION PRACTICES

FOR LETTUCE (*LACTUCA SATIVA*), SPINACH (*SPINACIA OLERACEA* AND *BASELLA ALBA*), AND LEAFY BRASSICA (*BRASSICA* SPP.)

COLEACP is an international network promoting sustainable horticultural trade.

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In accordance with the Millennium Development Goals, the global objective is to: "Maintain and, if possible, increase the contribution made by export horticulture to the reduction of poverty in ACP countries".

www.coleacp.org/pip

PIP

FOR SUSTAINABLE DEVELOPMENT OF THE ACP HORTICULTURAL INDUSTRY

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Programme PIP
COLEACP
Rue du Trône, 130 - B-1050 Brussels - Belgium
Tel.: +32 (0)2 508 10 90 - Fax: +32 (0)2 514 06 32

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Notice

The Guide to Good Plant Protection Practices details all plant protection practices regarding the production of the fruit or vegetables in question and recommends primarily the active substances supported by pesticides manufacturers in the framework of EU Directive 91/414, which must comply with European standards for pesticide residues. Currently, these active substances have not been tested by PIP in ACP countries to check their conformity with European MRLs. The information given on the active substances suggested is therefore changeable and will be adapted on an ongoing basis in accordance with the new information collected by PIP.

It is, of course, understood that only those products legally registered in their country of application are authorised for use. Growers must therefore check with the local regulatory authorities to see whether the product they wish to use is included on the list of registered products.

The PIP's crop protocols and guides to good phytosanitary practices are regularly updated. For further information, see the PIP website www.coleacp.org/pip

PIP
FOR SUSTAINABLE DEVELOPMENT OF THE ACP HORTICULTURAL INDUSTRY

Main leafy vegetables grown for baby leaf production in ACP countries are as follow :

Lolo rosso (*Lactuca sativa*)

Green cos (*Lactuca sativa*)

Red mustard (*Brassica juncea*)

Wild rocket (*Diplotaxis tenuifolia*)

Spinach (*Spinacia oleracea*)

Wild red spinach (*Basella alba* 'Rubra')

Table of content

1. Main pests and diseases

1.1. Extent and impact on the quantity and quality of leaves produced

The main pests and diseases that will be discussed in this guide are listed below. This section presents, for each pest or disease :

- the level of economic importance generally observed in ACP countries rated on the following scale : 0 = not on the crop, + = low, ++ = average, +++ = high. For plants of genus *Lactuca, Spinacia, Basella* or of the *Brassicaceae* familly ;
- the parts of the plant affected and how they are attacked;
- the resulting types of loss, all of which decrease the yield of marketable produce and consequently end up causing a loss of financial income. The presence of pests and diseases can reduce yield and cause losses at different levels : fewer plants per hectare, less leaves per plant, smaller-sized leaves, lower quality of leaves.

Quarantine organisms in Europe are followed by the abbreviation "QO".

INSECTS					
Extent	Organs attacked		Types of loss		
	Roots	Leaves	Number of plants	Size of plants	Quality of leaves at maturity
Green aphids *Myzus persicae* Spread viral diseases					
Lettuce ++ *Spinacia* + *Basella* + *Brassica* ++		Adults and larvae sucking		Stunted plants	Foliage contamination
White fly *Bemisia tabaci*					
Lettuce +++ *Spinacia* + *Basella* + *Brassica* +++		Adults and larvae sucking		Stunted growth	Aesthetic losses due to honeydew secretion
Caterpillar Various e.g. *Helicoverpa armigera Spodoptera exigua* and other caterpillars specific to brassica (*Plutella, Crocidolomia...*)					
Lettuce ++ *Spinacia* ++ *Basella* ++ *Brassica* ++		Eaten by larvae	Death of affected plants at seedling stage	Destruction of growing point	Reduced by characteristic windowing
Leafminer *Liriomyza* spp. QO					
Lettuce +++ *Spinacia* +++ *Basella* +++ *Brassica* +		Mined by larvae	Affected plants die	Damage (tunnelling) causes loss in photosynthetic leave surface	
Thrips *Frankliniella occidentalis* QO - Spread viral diseases					
Lettuce +++ *Spinacia* ++ *Basella* ++ *Brassica* +		Eaten by adults and larvae			Quality reduction by leave distortion

INSECTS (continued)					
Extent	Organs attacked		Types of loss		
	Roots	Leaves	Number of plants	Size of plants	Quality of leaves at maturity
Lettuce root aphid *Pemphigus bursarius*					
Lettuce + *Spinacia* 0 *Basella* 0 *Brassica* 0	Adults and larvae sucking		Death of plants	Wilt, stunted growth	
Flea beetles *Phyllotreta* spp.					
Lettuce 0 *Spinacia* + *Basella* + *Brassica* +		Eaten by adults	Death of plants if attacks on seedlings		Shot holes

FUNGI					
Extent	Organs attacked		Types of loss		
	Roots	Leaves	Number of plants	Size of plants	Quality of leaves at maturity
Powdery mildew *Erysiphe cichoracearum*					
Lettuce ++ *Spinacia* 0 *Basella* 0 *Brassica* ++		Mycelium develop on both the upper and lower surface of the leaf			Spots, which spread, leaves turn yellow and die
Downy mildew *Bremia lactucae* on Lettuce - *Peronospora effusa* on *Spinacia*					
Lettuce +++ *Spinacia* ++ *Basella* + *Brassica* +		Mycelium develop on both the upper and lower surface of the leaf			Lesions en leaves, which eventually die off
White mould *Sclerotinia sclerotiorum*					
Lettuce ++ *Spinacia* 0 *Basella* 0 *Brassica* 0	Attacks the upper roots and stem and then spread on leaves				Wilting and flattening of leaves which finally die
Damping off *Pythium* spp., *Rhizoctonia solani, Fusarium* sp.					
Lettuce +++ *Spinacia* ++ *Basella* ++ *Brassica* ++	Soil borne disease that develop in the roots and collar		Attacks young seedlings, which turn brown and die		

BACTERIA					
Extent	Organs attacked		Types of loss		
	Roots	Leaves	Number of plants	Size of plants	Quality of leaves at maturity
Leaf spot *Xanthomonas* spp.					
Lettuce +++ *Spinacia* + *Basella* + *Brassica* ++		Develop in whole plant. Could be seed borne			Small spots, then develop watery patches and leaf eventually rots

VIRUSES					
Extent	Organs attacked		Types of loss		
	Roots	Leaves	Number of plants	Size of plants	Quality of leaves at maturity
Tomato Spotted Wilt Virus (TSWV) QO - Transmitted by thrips					
Lettuce ++ *Spinacia* + *Basella* + *Brassica* 0		Spread in the whole plant after transmission by thrips		General stunting in plants Wilt of whole plant	Overall yellowing On young leaves causes purplish-brown spots; older leaves turn brown and droop
« Big-vein » – MiLV(Mirafiori Lettuce Virus) - Transmitted by a fungus *Olpidium brassicae*					
Lettuce + *Spinacia* 0 *Basella* 0 *Brassica* 0	Spread by a soil borne fungus which inhabits plant roots			Infected plants mature slowly	
Lettuce Mosaic Virus (LMV) - Transmitted by aphids					
Lettuce ++ *Spinacia* + *Basella* + *Brassica* +		Spread in the whole plant after transmission via seeds and aphids		Affected plants are stunted	Leaves mottle, yellow, get distorted and die. Vein clearing (loss of colour)

1.2. Identification and damage

This section provides information and illustrations to help with the identification of the main pests and diseases.

INSECTS

Green aphids - *Myzus persicae*

Aphids prefer to feed on tender leaf tissue on the growing tips or heads of the plant where they hide.

White fly - *Bemisia tabaci*

Whiteflies lay their eggs on the lettuce leaves and hatching larvae then plug into the leaves and suck sap. Additionally honey dew secretion and development of sooty mould occurs.

Caterpillars – e.g *Helicoverpa armigera*, *Spodoptera exigua*

Adult moths are mainly nocturnal and lay eggs on underside of leaves. Larvae feed causing characteristic windowing. Damage and destruction of growing point.

Damage on lettuce

Spodoptera exigua

Leafminer - *Liriomyza* spp.

Adults lay their eggs underneath the leaf cuticle and emerging larvae then tunnel their way through the leaf tissue causing direct damage and creating entry wounds for secondary infestation by diseases.

Punctures by adults

Mines done by larvae

Thrips - *Frankliniella occidentalis*

Thrips feeding on lettuce results in scarring and leaf distortion.

Lettuce root aphid - *Pemphigus bursarius*

Lettuce root aphids infest the roots through the soil. When they pierce the roots to feed plants lose nutrients and water thus causing wilting, stunted growth and eventual death if not controlled.

Flea beetles - *Phyllotreta* spp.

Small jumping beetle that punctures leaves while feeding, may also attack seedlings. Eggs are laid on host plant or soil nearby.

Adult

FUNGI

Powdery mildew - *Erysiphe cichoracearum*

The disease appears as a powdery growth on both the upper and lower surface of the leaf which then turn brown and dry under heavy infestation.

Downy mildew - *Bremia lactucae*

Initially there are irregular shaped chlorotic lesions on upper leaves, and white or grey downy fungal growth develops on lower leaves. The lesions coalesce as the disease progresses.

White mould - *Sclerotinia sclerotiorum*

The fungus attacks the upper roots and stem with tissue decaying and dieing. A white fluffy fungal mass develops on leaves nearer the ground and dark fungal growths called sclerotia finally develop on the decayed tissue.

Damping off - *Pythium* spp.

This is caused by a soil fungus which attacks young seedlings causing them to turn brown and thin just above the soil level before eventually falling over and dieing.

BACTERIA

Leaf spot - *Xanthomonas* spp.

This disease is characterised by small (less than 5 mm) angular water soaked leafspots on the older leaves of the plant. Lesions turn black under severe infestations and this causes leaf drop.

VIRUSES

Tomato Spotted Wilt Virus (TSWV)

Tomato spotted wilt virus symptoms include overall yellowing, spots on leaves or terminal shoots and general stunting. Brown streaks occur on the leaf and plant stems.

"Big-vein" (LiMV)

Affected plants exhibit vein clearing which makes the leaf veins look bigger.

Lettuce Mosaic Virus (LMV)

The infection is systemic and infected plants exhibit stunted growth, leaves are mottled, turn yellow and get distorted before dieing off. Veins lose their colour and hearts are malformed.

1.3 Appearance of pests and diseases in terms of the phenological stage of the plant

The following table shows the stages of cultivation during which crop enemies are potentially present and the stages during which their presence can do the most harm. It is especially during the latter stages that they must be monitored and controlled if necessary. The purpose is to show that the presence of a pest, disease or pathogenic agent is not always harmful to the crop.

Stage	Length of stage	Green aphids		Whitefly		Caterpillars		Leafminer		Thrips		Flea beetles	
Seeds													
Germinating seeds and seedlings	1 week												
From emergence to 2 weeks after emergence	2 weeks												
From 2 weeks after emergence to harvest	4-8 weeks												

Stage	Length of stage	Downy mildew		White mould		Damping off		Leaf spot		TSWV		LiMV		LMV	
Seeds															
Germinating seeds and seedlings	1 week														
From emergence to 2 weeks after emergence	2 weeks														
From 2 weeks after emergence to harvest	4-8 weeks														

- Periods during which pest or pathogenic agent is potentially present
- Periods during which the appearance of a large numbers of pest or pathogenic agent can cause the greatest loss.

1.4 Extent according to country/time of year and climate conditions favourable to crop enemies

Legend :
KEN = Kenya,
0 = no damage
+ = light damage
++ = medium damage : control needed
+++ = serious damage : control essential
X = light damage but importance by month not known
XX = medium damage but importance by month not known
XXX = serious damage but importance by month not known
/ = no information available
N.B. the inventory of pests and diseases has not been conducted exhaustively in all countries. The pest or disease may be present, but has perhaps never been observed in the country on the crop, because it does not cause serious damage.

Green aphids – *Myzus persicae*

Favourable conditions : Become a problem in hot and dry conditions.

Month	1	2	3	4	5	6	7	8	9	10	11	12
KEN	++	++	++	+	+	++	++	++	++	+	+	+

White fly – *Bemisia tabaci*

Favourable conditions : High air humidity and high temperature favour infestations.

Month	1	2	3	4	5	6	7	8	9	10	11	12
KEN	++	+++	+++	+	+	++	++	++	++	+	+	+

Caterpillars – various e.g. *Helicoverpa armigera, Spodoptera exigua*

Favourable conditions : Occurrence difficult to predict but can occur after rains.

Month	1	2	3	4	5	6	7	8	9	10	11	12
KEN	++	+	+	+	+	++	++	+	+	+	0	++

Leafminer – *Liriomyza* spp.

Favourable conditions : In Kenya mostly in hot period.

Month	1	2	3	4	5	6	7	8	9	10	11	12
KEN	++	+++	+++	++	+	+	+	+	++	++	+	+

Thrips - *Frankliniella occidentalis*

Favourable conditions : Mostly when weather is hot and dry.

Month	1	2	3	4	5	6	7	8	9	10	11	12
KEN	++	+++	+++	++	+	+	+	+	++	++	+	+

Lettuce Root Aphid - *Pemphigus bursarius*

Favourable conditions : Dry weather and cracks on the soil are favourable for this pest.

Month	1	2	3	4	5	6	7	8	9	10	11	12
KEN	+	+	+	+	+	+	+	+	+	+	+	+

Flea beetles – *Phyllotreta* spp.

Favourable conditions : All year round, but mainly in dry weather.

Month	1	2	3	4	5	6	7	8	9	10	11	12
KEN	+	++	++	++	+	+	+	+	++	++	+	+

Powdery mildew – *Erysiphe cichoraciarum*

Favourable conditions : Warm weather (24 to 30°C), no rain, with relative humidity between 50 and 90%. Very high humidity is needed for spore germination. Powdery mildew is favoured by alternating humid (but rain-free) and dry periods.

Month	1	2	3	4	5	6	7	8	9	10	11	12
KEN	+	++	++	+	+	+	+	+	++	++	+	+

Downy mildew – *Bremia lactucae*

Favourable conditions : Can occur in any season but particularly in cool, moist environments.

Month	1	2	3	4	5	6	7	8	9	10	11	12
KEN	0	0	0	+++	+++	0	++	++	+++	+	0	0

White mould – *Sclerotinia sclerotiorum*

Favourable conditions : Thrives in warm, moist conditions, usually when foliage is dense and senescing.

Month	1	2	3	4	5	6	7	8	9	10	11	12
KEN	0	0	0	++	++	0	+	+	+	+	++	0

Damping off – *Pythium* spp.

Favourable conditions : Damp and heavy soils with difficult germination conditions.

Month	1	2	3	4	5	6	7	8	9	10	11	12
KEN	+	+	+	++	+++	+	+	+	+	+	+++	+

Leaf spot – *Xanthomonas* spp.

Favourable conditions : Warm and wet conditions.

Month	1	2	3	4	5	6	7	8	9	10	11	12
KEN	0	0	0	+++	+++	0	0	0	0	+	+++	+

Tomato spotted wilt virus (TSWV)

Favourable conditions : When thrips present, usually in drier conditions.

Month	1	2	3	4	5	6	7	8	9	10	11	12
KEN	+	++	++	++	+	+	+	+	++	++	+	+

"Big-vein" (LiMV)

Favourable conditions : unknown.

Month	1	2	3	4	5	6	7	8	9	10	11	12
KEN	+	+	+	+	+	+	+	+	+	+	+	+

Lettuce Mosaic Virus (LMV)

Favourable conditions : More abundant in periods favourable to aphids.

Month	1	2	3	4	5	6	7	8	9	10	11	12
KEN	++	++	++	+	+	+	+	++	++	++	+	+

2. Main control methods

2.1. Introduction

The control pest and diseases requires an integrated approach with the use of cultural, physical, biological and pesticides. The major pests include aphids, leaf miner and a range of diseases. However the short term nature of the crop does not always allow the build up of pest and disease problems over a longer period. The rapid production cycle is therefore an advantage as they reduce the need for pest and disease control measures.

Physical controls

It is feasible to use physical barriers such as insect proof netting over the crop to prevent the influx of many pests. This minimises the need for using Plant Protection Products whilst control flying pests. The cost of the netting is an initial capital cost, however where some flying insects are extremely difficult to control by chemical means e.g. leaf miner, white fly, thrips; a physical barrier is a valuable method of control.

Rotation

Rotate with most other field vegetable crops.

Tillage

Burial of crop residues, is beneficial in reducing pathogen survival and inoculum for the succeeding crops. The burial of infested debris facilitates rotting and deprives the pests and diseases of a food base. However *Sclerotinia* can survive on crop debris and remain in the soil some years. Disking does not sufficiently bury the infested debris. Mold board ploughing does, but it may not be advisable in some fields because of increased erosion potential. Burial of infested debris, however, may not provide an effective means of reducing some disease inoculum in regions where widespread use of conservation tillage is practiced because the pathogens may blow into a field from adjacent fields.

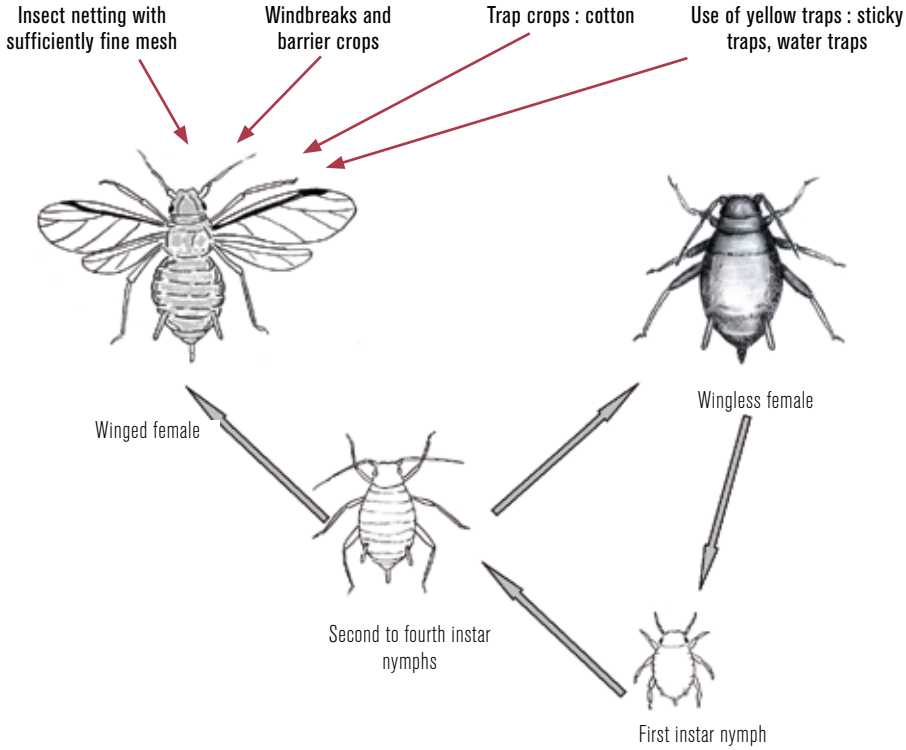
2.2. Pest or disease cycle; positioning of control methods and factors influencing the development of the cycle

Based on the stages of development of each pest or disease, the following are the applicable control methods, as well as the effects of natural factors other than those related to climate, which are described in Part 1.4. of this guide. The control methods are then positioned in terms of the plant's development cycle.

N.B. : the illustrations of the cycles represent the different stages of development, but in no case should these illustrations be used to identify pests or diseases. For identification, please return to part 1.2 of this guide.

APHIDS

Positioning of control methods in terms of the development stage of the pest



To control all stages

- Natural heavens to encourage natural enemies e.g. beetles and hoverflies, *Aphidius*
- Use of selective insecticides : soap solutions, neem products
- Sprinkler irrigation, strong rain
- Natural enemies : Parasitic wasps, predators (ladybird beetles, hoverflies, lacewings)
- Control ants in the field, as these will disrupt natural enemy activities

Positioning of control methods in terms of the development cycle of the plant

Field

Throughout the production cycle

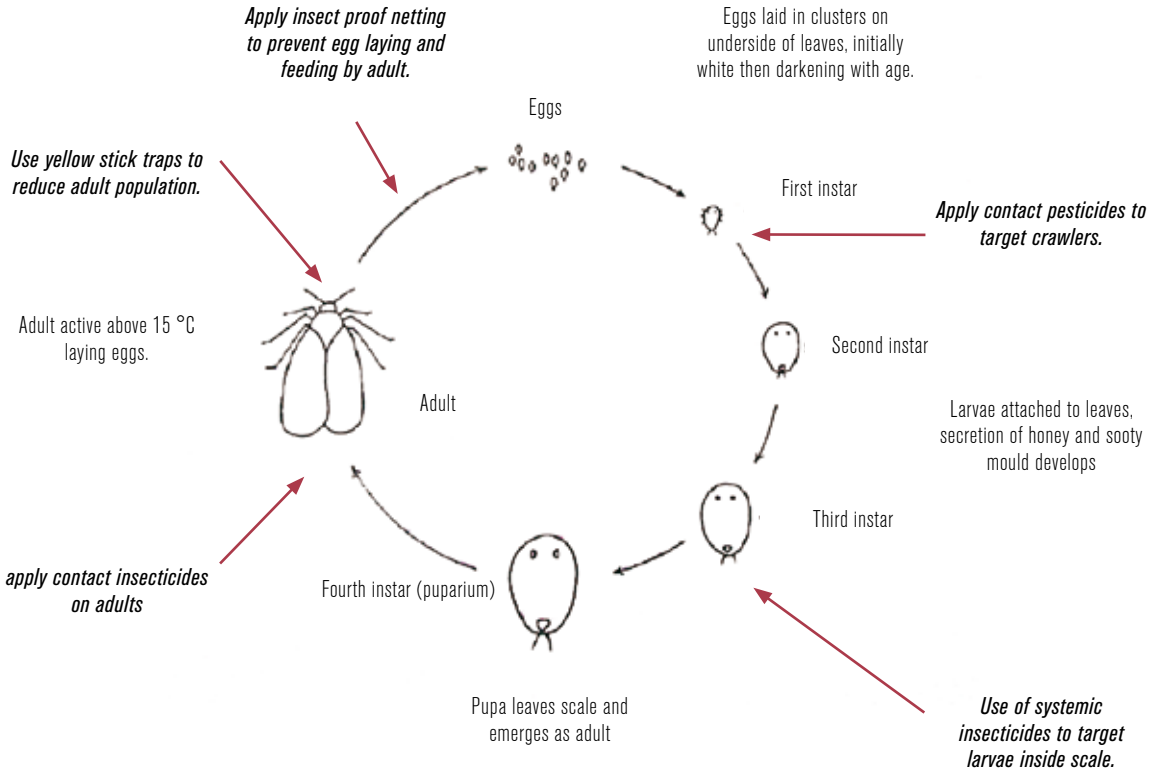
- Insect netting with sufficiently fine mesh can prevent the presence of adults on the plants.
- Sprinkler irrigation or sustained rain can reduce infestation washing-off aphids.
- Install yellow traps in the plot to monitor the population level and to reduce infestation somewhat; it is imperative to detect attacks at the earliest stage of cultivation to limit the risks of early transmission of viruses or direct damage by large populations of aphids.
- Treatment with a selective insecticide upon detection of attacks on young plants.
- Use compatible insecticides such as physical oils or detergents to minimise the effect of insecticides on natural enemies like lady birds and Aphidius which parasites aphids.
- Introduce natural enemies into colonies of the crop to allow multiplication.

After the final harvest

- Pull up the plants as soon as they have stopped producing.

WHITE FLY

Positioning of control methods in terms of the development stage of the pest



Positioning of control methods in terms of the development cycle of the plant

Field

At field preparation

- Select production site that is isolate from other crops which are hosts to white fly.

From sowing or transplanting to harvesting

- Insect netting with sufficiently fine mesh can prevent the presence of adults on the plants.

During sensible stage of the plant (see 1.3.)

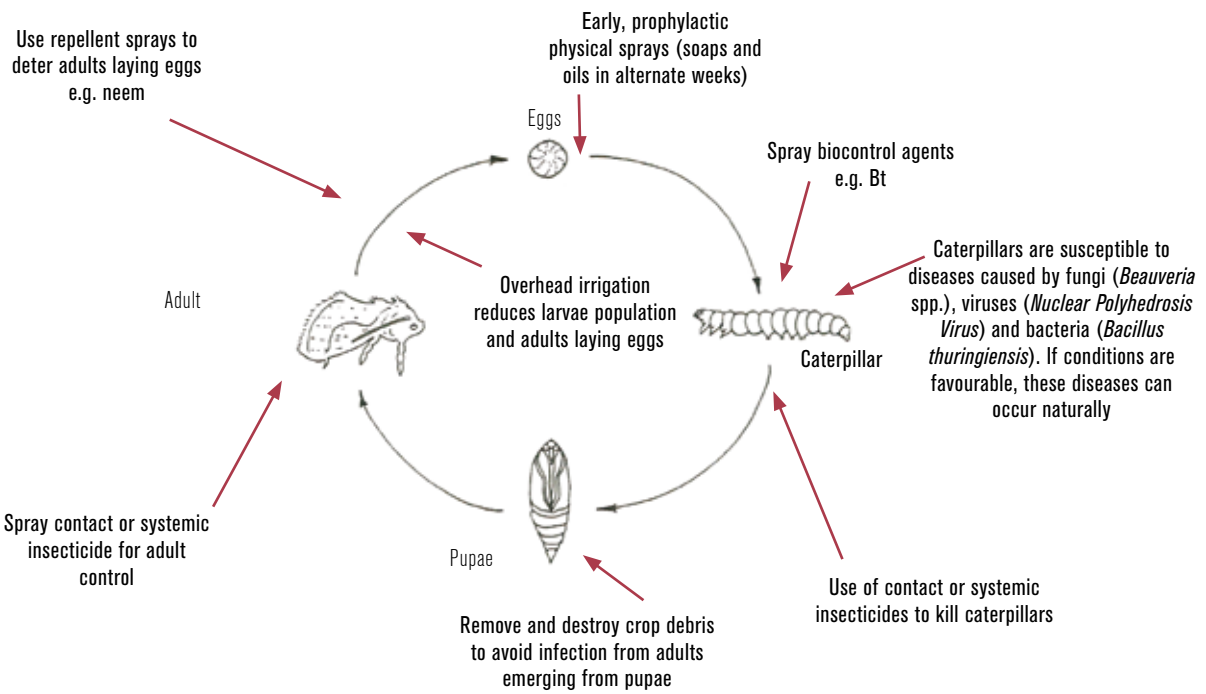
- Use systemic insecticides to control larvae stage inside the scale as they feed on the plant sap.
- Use sticky traps to reduce adult populations.
- Apply contact insecticides to target adults and crawlers, apply at cooler times of day before adult is air borne and use yellow stick traps to reduce adult population.

After the final harvest

- Remove crop and source of further adult white flies.

CATERPILLARS

Positioning of control methods in terms of the development stage of the pest



Positioning of control methods in terms of the development cycle of the plant

Field

From sowing or transplanting to harvesting

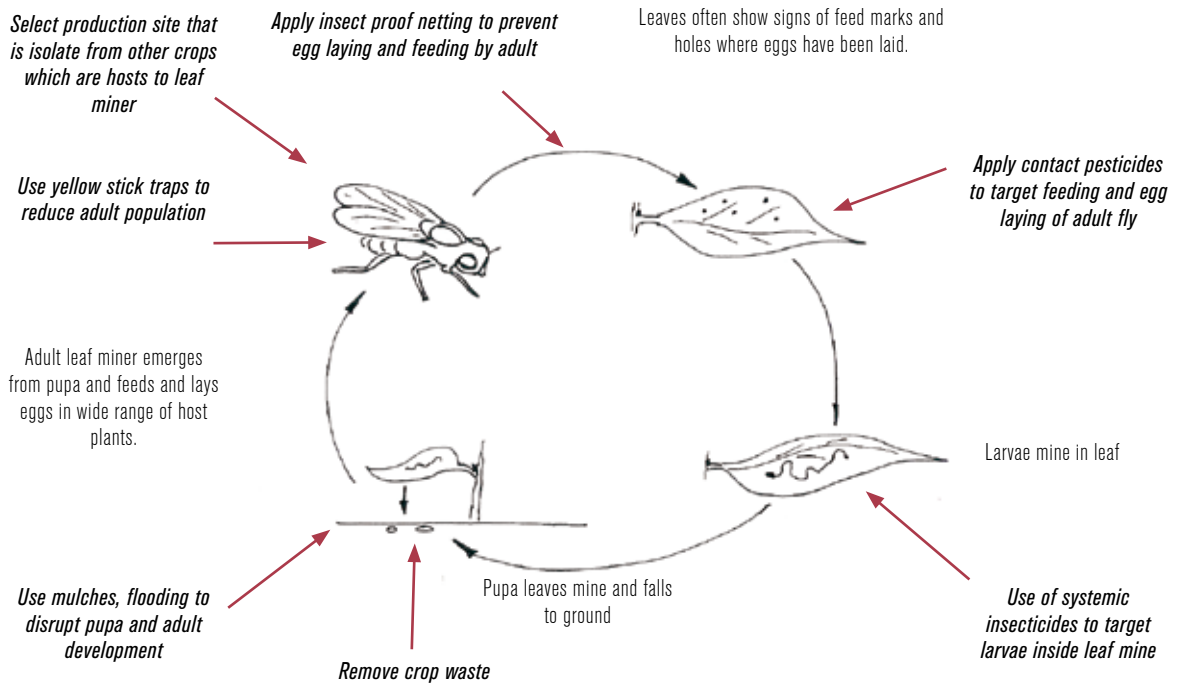
- Repellent sprays such as those containing neem will deter adults coming into the crop.
- Use of contact or systemic insecticides to kill adults.
- Early, prophylactic physical sprays (soaps and oils in alternate weeks) will suffocate caterpillar eggs.
- Control larvae stages at all times by using a range of insecticides. *Bacillus thuringiensis* is the preferred spray, but products must be alternated to prevent resistance – apply only in evening as it is broken down by UV light – add a wetter to improve persistence.

After the final harvest

- Remove and destroy crop debris to avoid infection from adults emerging from pupae and laying eggs on new or younger crops.

LEAFMINER

Positioning of control methods in terms of the development stage of the pest



Positioning of control methods in terms of the development cycle of the plant

Field

At field preparation

- Select production site that is isolate from other crops which are hosts to leaf miner.
- Flooding soil to reduce pupa development.
- Use plastic mulch to reduce pupation in soil and emergence of adults from soil pupa.

From sowing or transplanting

- Apply crop covers to control influx of adults and egg laying in leaves of crop.
- Apply contact insecticides to control adult flies.
- Use yellow stick traps to reduce adult population.

During sensible stage of the plant (see 1.3.)

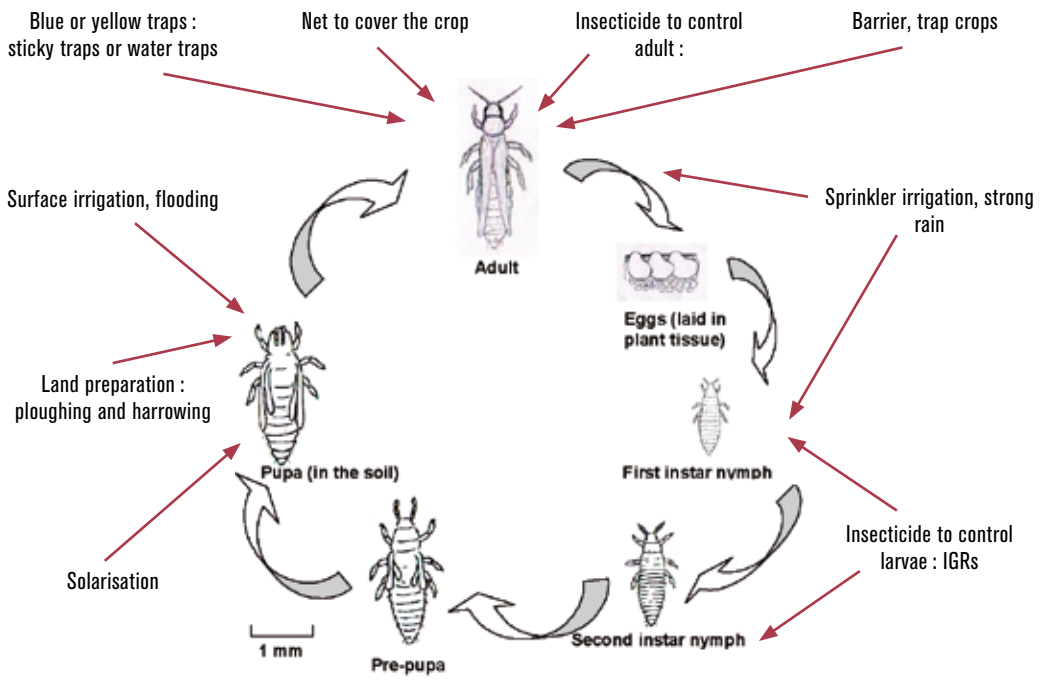
- Use systemic insecticides to control larvae stage inside the leaf mine.

After the final harvest

- Remove crop and source of further adult leaf miners, however where *Diglyphus* present crop waste is an importance source of natural enemy.

THRIPS

Positioning of control methods in terms of the development stage of the pest



To control all stages : Natural enemies : predatory mites, predatory thrips, pirate bugs, *Entomophthora*.

Positioning of control methods in terms of the development cycle of the plant

Field

At field preparation

- Surface irrigation and flooding.
- Prepare land by ploughing and harrowing.
- Use barrier trap crops.
- Do solarisation of the soil.

From sowing or transplanting to harvesting

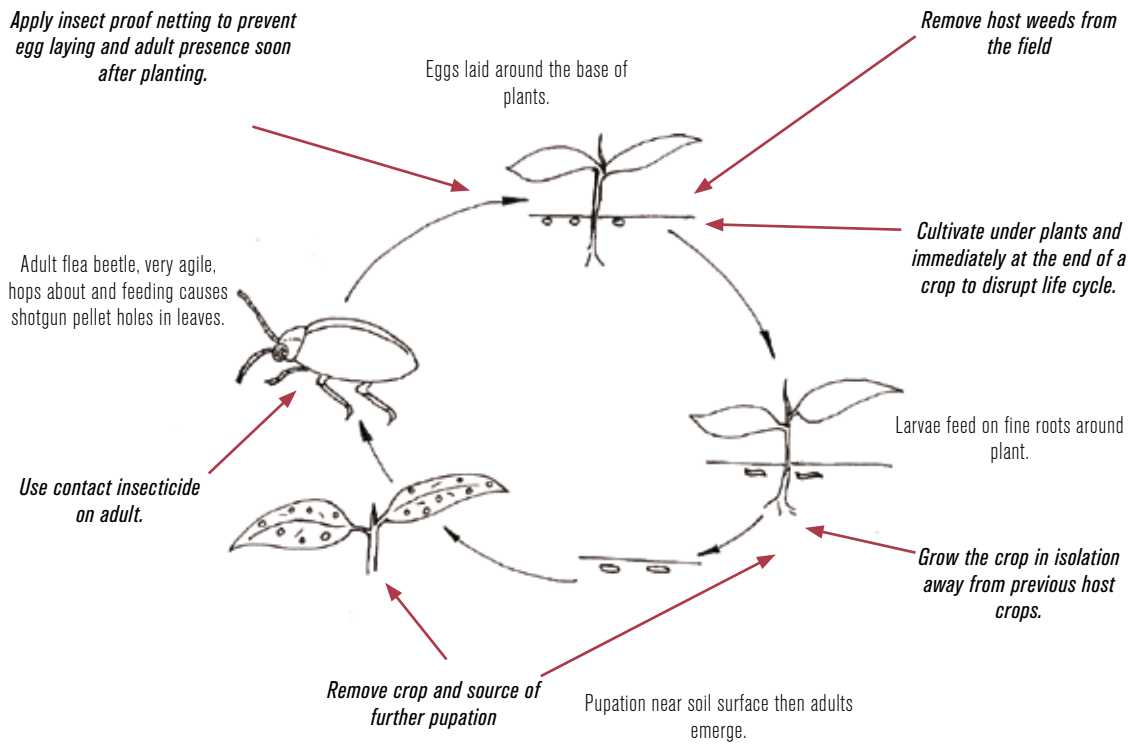
- Insect netting with sufficiently fine mesh can prevent the presence of adults on the plants.
- Use sprinkler irrigation to wash-off the thrips.

During sensible stage of the plant (see 1.3.)

- Use insecticides to control larvae and adults.
- Use insecticide safe for natural enemies.
- Use insecticides to control adults.
- Use traps.

FLEA BEETLE

Positioning of control methods in terms of the development stage of the pest



Positioning of control methods in terms of the development cycle of the plant

Field

Before transplanting

- Select production site that is isolate from other eggplants crops to reduce of cross over of flea beetles.

After transplanting

- Apply crop covers to control influx of adults and egg laying at the base of plants.

During sensible stage of the plant (see 1.3.)

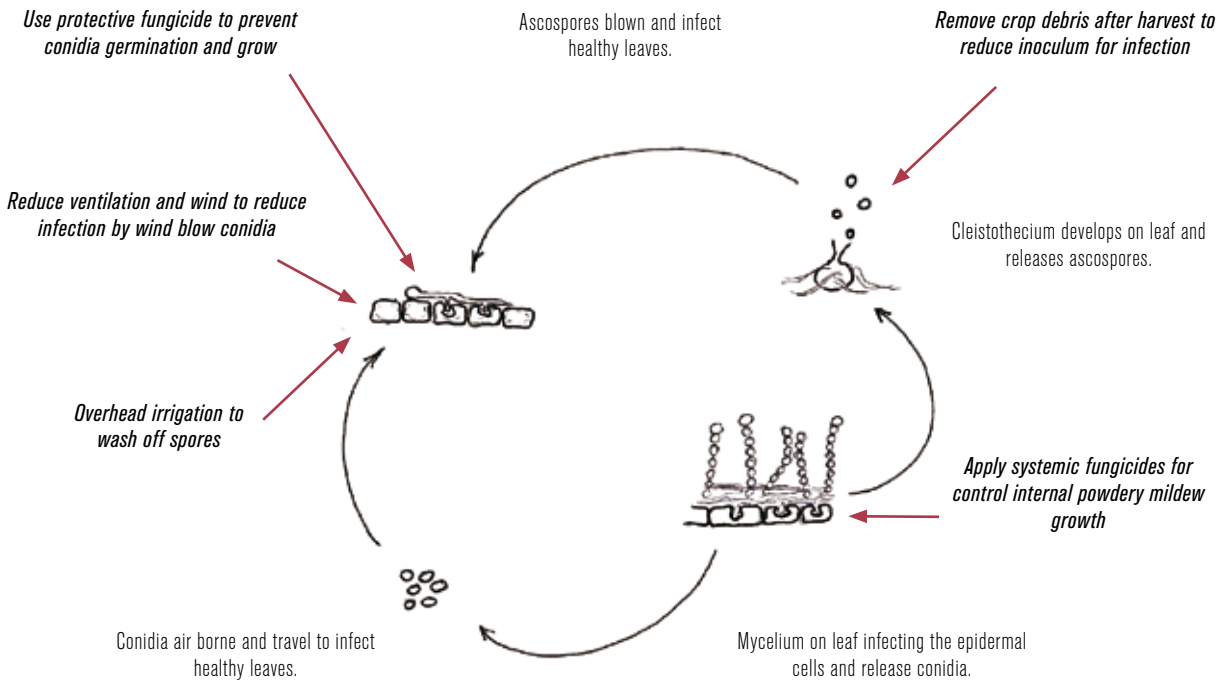
- Cultivate under crops and immediately at the end of a crop to disrupt the life cycle of the flea beetle by destroying eggs and larvae.
- Use repellant sprays such as neem based products.
- Spray contact pesticides for control of Flea beetle adults
- Remove host weeds from the field.

After last harvesting

- Remove crop and source of further pupation.

POWDERY MILDEW

Positioning of control methods in terms of the development stage of the disease



Positioning of control methods in terms of the development cycle of the plant

Field

Before sowing and during crop development

- Avoid irrigation systems that don't wet leaf.

During sensible stage of the plant (see 1.3.)

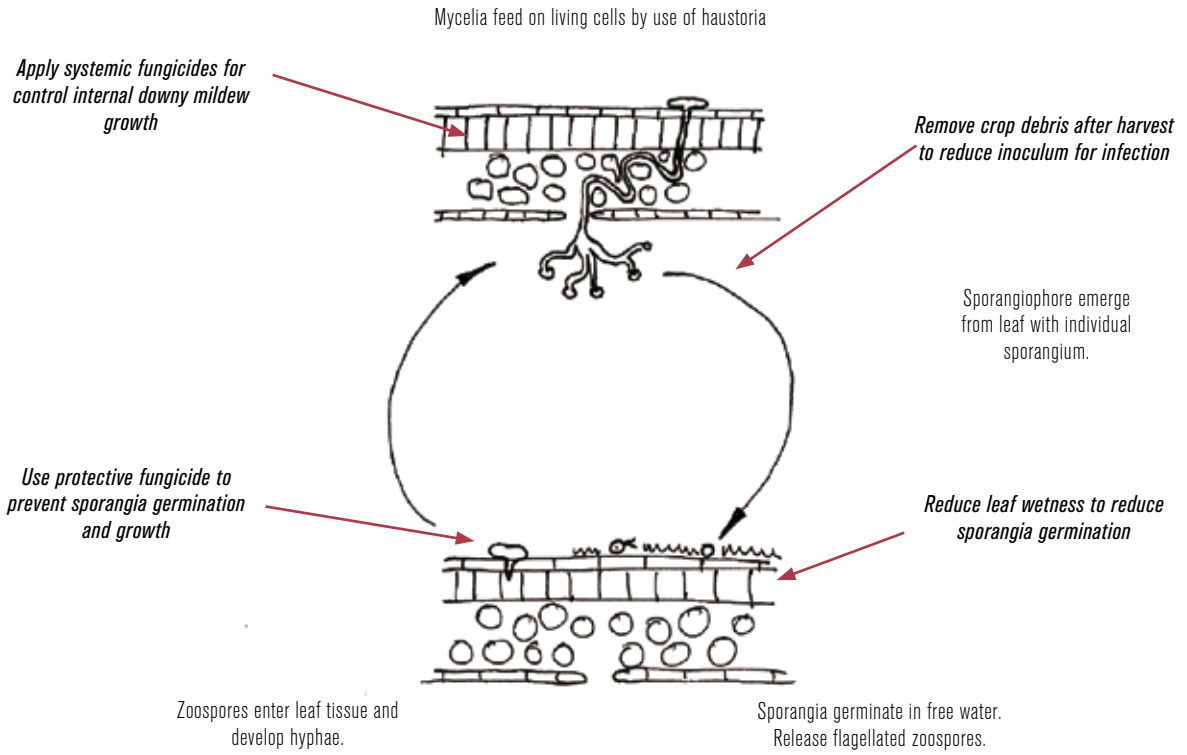
- Apply protective fungicides where conditions are expected to encourage powdery mildew infections.
- Apply systemic fungicides for control internal powdery mildew growth.

After last harvesting

- -Remove old crop as source of additional inoculum.

DOWNY MILDEW

Positioning of control methods in terms of the development stage of the disease



Positioning of control methods in terms of the development cycle of the plant

Field

Before sowing and during crop development

- Avoid irrigation systems that wet leaf especially in humid conditions.
- Apply crop covers to reduce leaf wetness.
- Increase crop spacing in rainy season to encourage air movement.

During sensible stage of the plant (see 1.3.)

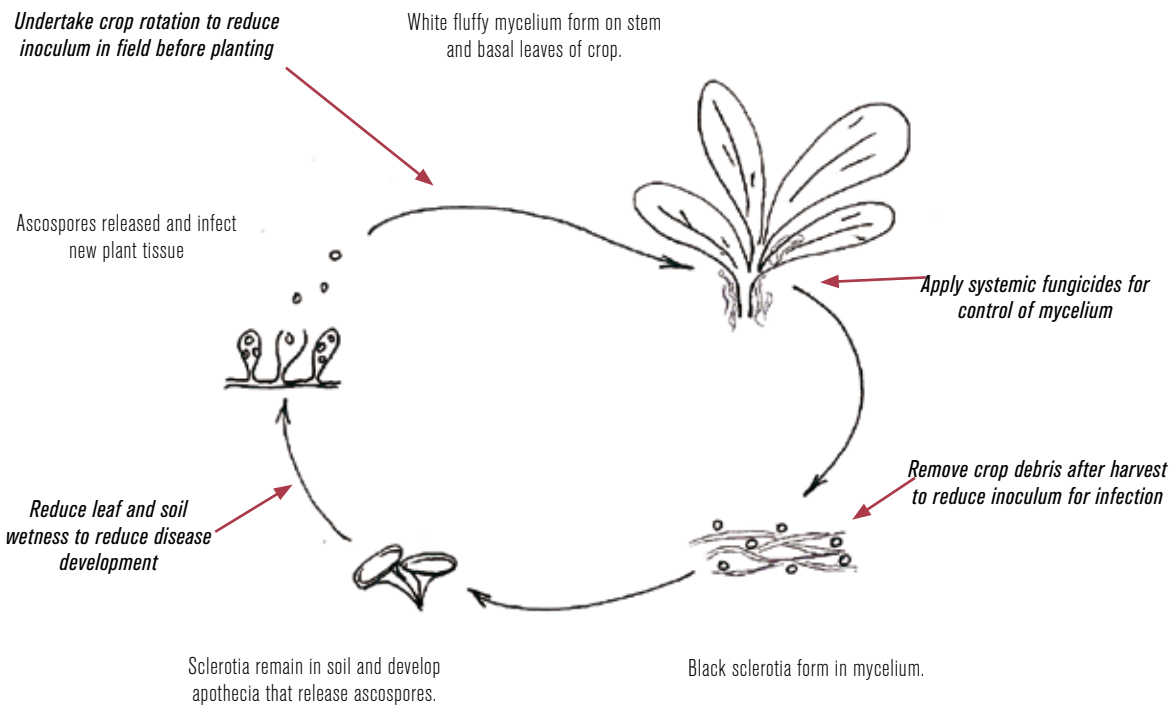
- Apply protective fungicides where conditions are expected to encourage downy mildew such as the rainy season.
- Apply systemic fungicides for control internal downy mildew growth.

After last harvesting

- Remove old crop as source of additional inoculum.

SCLEROTINIA SCLEROTIORUM

Positioning of control methods in terms of the development stage of the disease



Positioning of control methods in terms of the development cycle of the plant

Field

Before sowing and during crop development

- Avoid irrigation systems that wet leaf and soil in excess especially in humid conditions.
- Undertake crop rotation and practice crop hygiene.
- Increase crop spacing in rainy season to encourage air movement.

During sensible stage of the plant (see 1.3.)

- Apply fungicides where history of disease is known.

After last harvesting

- Remove old crop as source of additional inoculum.

DAMPING OFF – *PYTHIUM* SPP., *RHIZOCTONIA SOLANI* AND *FUSARIUM* SP.										
Development stage of the fungus	Action	Cultivation stages								
		Nursery substrate and environment preparation	Sowing	Nursery	Choice of piece of land	Field preparation	Transplanting	From transplanting to harvest	After last harvesting
Germination on plant	Seedbed conditions should not be too moist	X		X					
	Regulate irrigation programme to avoid over watering or stress							X	
	Space rows and/or seedlings in the seedbed to maximize air movement		X	X					
	Avoid water logging areas when planting. Planting on raised bed and providing good drainage				X	X	X		
	Apply fungicides as seed treatment		X						
Development in plant	Apply fungicides as spraying or drenching	X		X			X		
Development on crop or weeds	Remove and destroy infected plants.			X			X		
Conservation in the soil	Steam, heat (65°C for 30 minutes) and solar treatment of soil and growing media will help to kill the disease	X				X			
	Use clean and/or sterile soil.	X		X	X				
	Rotation with cereals may reduce pathogen *Rhizoctonia* in soil.				X	X			X
	Apply fungicides to the soil.	X				X			

X = action to be taken at the cultivation stage shown in the corresponding column

LEAF SPOT – *XANTHOMONAS* SPP.

- There are no chemical controls available, so disease prevention is very important.
- The bacteria can survive in and on seeds from infected plants. It can remain alive on plant residue buried in the soil for up to two years.

Development stage of the bacteria	Action	Cultivation stages							
		Nursery substrate and environment preparation	Sowing	Nursery	Choice of piece of land	Field preparation	Transplanting	From transplanting to harvest	After last harvesting
Infection on plant	Use certified disease-free seed.		X				X		
	Do not plant sensible crops where leave spot has occurred in the past two to three years.				X				
	Select well-drained sites with good air circulation.				X				
Development in plant	Some differences in susceptibility exist among cultivars.		X						
Transport by equipment or water	Avoid contaminated water. If plants are grown up river and irrigation water is taken from the river, samples should be tested regularly. If contaminated treat with peroxygen or chlorine dioxide.			X			X	X	
	Regularly clean and disinfect all machinery and equipment.					X			
	Not handling plants when they are wet will reduce the spread of disease-causing organisms						X	X	
	Use mulch to reduce movement of spores by rain splash.					X	X		
Development on crop or weeds	Remove weeds from within and around field to reduce secondary infection from alternative hosts.					X	X	X	
Conservation in the soil	Carry out a good crop rotation (at least 3 years) which avoids repeated plantings of sensible crops on the same piece of land				X				
	Use clean and/or sterile soil.	X			X				
	Crop trash should be removed from the field and destroyed immediately after harvest.								X

X = action to be taken at the cultivation stage shown in the corresponding column.

VIRUSES

Tomato Spotted Wilt Virus

TSWV is transmitted by certain thrips species, the main one being the western flower thrips *Frankliniella occidentalis*. The disease affects many plants. The virus is present in the seed coat and weed hosts. The virus is acquired by the larval stage of the thrips and after an incubation period of 3-10 days it can be transmitted. Transmission is mostly by adult thrips and takes about 22-30 days.

"Big-vein" Virus

Olpidium brassicae rserves two important functions in the big vein disease. Zoospores of this fungus are produced under saturated soil conditions and transport the pathogen internally and inoculate it into lettuce root cells. Resting spores of *Olpidium* carry the pathogen internally and allow it to survive in soil from crop to crop for a minimum of eight years. *Olpidium* has a wide host range, including wild species of lettuce, celery, radish, onion and broccoli. Disease incidence is higher in heavy textured poorly drained soils where zoospore production is favoured by saturated soil conditions

Lettuce Mosaic Virus

This virus is transmitted by aphids particularly *Myzus persicae* and *Macrosiphum euphorbiae* and seeds. The aphid deposits the virus on the host which enters the cell and the protein coat is removed. RNA is copied many times and some of the copies remain as uncoated RNA molecules and move into adjacent cells to promote further infection. Aphids can obtain the virus after only brief contact with an infected plant and usually retain the virus for less than an hour.

2.3. Resistant or tolerant varieties

There are reports of lettuce being resistant to strains of downy mildew and these are published by the seed producers in their catalogues. It is important that the grower is aware of which strain of downy mildew they have. There is limited availability of other pest and disease resistant varieties.

2.4. Importance and use of auxiliaries

Though there are natural enemies for some of the pests such as white fly, leaf miner and aphids, in practice none have been used to date by growers. This is partly due to them not being available and also these crops are relatively short term and their use has not been integrated into this type of programme.

3. Monitoring the phytosanitary state of the crop and intervention thresholds

Guidelines

The block should be scouted once per week, at the same time of day throughout its life - for accurate comparison of pest levels.
If more than one spray is considered necessary per week - a second scout record should be produced to justify the second spray.

For every planting, sampling should be undertaken at ten stations. At each station examine the leaves which will be from a range of different plants in an area 30 x 30 cm. Always scout in the stations in the same order so that comparisons can be made each week. (The total number recorded at station 1 each week can be compared to the number recorded at station 1 the next week.)

Indicative thresholds proposed :

Green aphids	Calculate percentage of plants affected and treat when above 1 %
White fly	Calculate percentage of plants affected and treat when above 1 %
Caterpillars	Calculate percentage of plants affected and treat when above 1 %
Leaf Miner	Calculate percentage of plants affected and treat when above 1 %
Thrips	Calculate percentage of plants affected and treat when above 1 %
Lettuce root aphid	Calculate percentage of plants affected and treat when above 1 %
Flea beetles	Calculate percentage of plants affected and treat when above 1 %

Diseases : record number of diseased leaves on plants.

Powdery mildew	Protectant/Erradicant spray when first seen
Downy mildew	Protectant/Erradicant spray when first seen
White mould	Protectant/Erradicant spray when first seen
Damping off	Protectant/Erradicant spray when first seen
Leaf spot	Protectant/Erradicant spray when first seen
Viruses	If more than 1 % affected, consider control action against known vector

SCOUTING field in a W pattern.
Any hotspots of pests or disease should be identified.
THEN, bring this to the attention of the Farm Manager for possible spot treatment.
Always scout the numbered stations in the same order - so they can be compared each week.

Guidelines on completion of the weekly summary sheets

On a weekly basis, transfer the average figures per STATION from the scouting forms to this weekly summary.

Check that the TIME OF DAY the scouting took place each week was the SAME (within half an hour) for all previous scout reports.

Indicate time of day scouted in the column provided (a block should always be scouted at the same time of day).

It is important to remember that these are figures per station i.e. from an area of leaves 30 x 30 cm in a bed that might be 100 cm wide.

A build up of pest levels is expected and is only a risk if the ratio of beneficial to pest is not increasing, or the % parasitism is not increasing.

Graphs of weekly changes in ratios and average number of pest per station can be made manually to plot progress.

Enter all sprays and beneficials applied to the crop on a weekly basis (so that up to date information is available on the weekly crop walk).

The weekly summary sheet should be used DURING THE WEEKLY CROP WALK to make decisions about risk and progress of IPM.

The effect of sprays on beneficials as well as pest will be clear from changes in ratios or average per leaf.

Keep records of observations of pesticide sensitivities observed and share this information with other managers.

Farm	Block
Crop age (wks)	Date scouted
Scout name (PRINT)	TIME of DAY Scouted

Pests								Diseases						
Station	Green aphids	White fly	Caterpillars	Leafminer	Thrips	Lettuce root aphid	Flea beetles	Station	Powdery mildew	Downy mildew	White mould	Damping off	Leaf spot	Viruses
1								1						
2								2						
3								3						
4								4						
5								5						
6								6						
7								7						
8								8						
9								9						
10								10						
total								total						
av.per station								av.no. diseased						
Percent								leaves / plant						

Other observations : (distribution of problem, other symptoms or problems, waterlogging, drip lines blocked etc)

4. Active substances and treatment recommendations

Introduction

For each pest or disease, proposals of the strategy for the use of Plant Protection Products (PPP) are indicated below.

A list of active substances is suggested for each pest or disease. When available, the critical GAP which allows compliance with European harmonised MRLs currently in force is also shown. Any change in one or more elements of these GAPs (increase in the doses, frequency of application and number of applications, last application before harvest not respecting the recommended pre-harvest interval) can result in residues in excess of the MRL in force. At this stage, however, it is worth noting that no tests have been carried out in ACP production environments to check compliance of MRLs with the GAPs indicated. These GAPs does not represent a treatment calendar to be applied as such. In practice, the frequency of treatments must take account locally of the severity of attacks and the real risks of damage

The list of active substances proposed has been drawn up taking into account the products used by ACP producers and the products registered in ACP countries and in Europe. It is nevertheless worth noting that not all the ACP producers contacted provided information on the PPP used. The products mentioned by producers have been underlined in the tables. The active substances are classified by resistance risk group (classification and codes of FRAC - Fungicide Resistance Action Committee - http ://www.frac.info/frac/index.htm and IRAC - Insecticide Resistance Action Committee - http ://www.irac-online.org/). In practice, it is important to alternate active substances belonging to different groups.

The most appropriate development stages of the crop (green boxes) for the application of each active substance are also suggested, taking into account the pre-harvest interval to be respected so as to comply with MRLs, the modes of action of the active substances and the effects on natural enemies.
Other PPPs not shown in the following tables can be effective, for example, neem extract (to control aphids, whitefly, beetles, etc.), wood ash (to combat aphids, etc.), garlic and soap solutions (to control various insects). The effectiveness of this type of PPP depends in large measure on the origin of the raw materials used, so efficacy needs to be checked locally.

Commercial soap-based PPPs (to control aphids, whitefly, etc.) also exist and are not listed in the following tables because they pose no problems in terms of residues.

Green aphids - *Myzus persicae*

Strategy : Scout at least once per week, use pesticides with short PHIs as crop is short term.

Active substance	Recommended GAP*					Proposed application period	
	Crop	Dose g/ha	Maximum number applications	Minimum interval between applications (days)	Pre-harvest interval (days)	Before sowing	From emergence to harvest
Group 3 - Pyrethroids							
Alpha cypermethrin	Lettuce and similar crops	9	1	n.a.	14		
Bifenthrin	Lettuce	12	/	/	/		
Cypermethrin	/	/	/	/	/		
Deltamethrin	Lettuce and spinach	7,5	4	14	7		
Gamma-cyhalothrin	/	/	/	/	/		
Pyrethrin	Lettuce	75-100	/	/	2		
Lambda-cyhalothrin	Lettuce and spinach	20	2	15	3		
Tau-fluvalinate	/	/	/	/	/		
Group 1 – Organophosphates and carbamates							
Acephate	All crops	375	3	15	21		
Dimethoate	/	/	/	/	/		
Methomyl	Lettuce	250-450	2	14	21		
	Spinach	250-450	1	n.a.	35		
Pirimicarb	/	/	/	/	/		
Pirimiphos methyl	/	/	/	/	/		
Group 9							
Pymetrozine	Lettuce	200	3	7	7		
Group 4 – Nicotinic Acethylcholine receptor agonists/antagonists							
Imidacloprid	/	/	/	/	/		
Thiacloprid	/	/	/	/	/		
Acetamiprid	Lettuce , rockets and leaves and sprouts of Brassica	50	2	7	7		
	Red mustard and other salad plants	65	2	14	14		
Thiocyclam hydrogenoxalate	All crops	500	3	7	7		
Group 18 – Ecdysone aganists/moulting disruptors							
Azadirachtin		15-60	No limit	7	2		
Group 21							
Rotenone	/	/	/	/	/		

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL.
/ : elements of the recommended GAP not available
n.a. : non applicable

White fly - *Bemisia tabaci*

Strategy : scout at least once per week, use sticky traps as monitoring, use pesticides with short PHIs as crop is short term.

Active substance	Recommended GAP*					Proposed application period	
	Crop	Dose g/ha	Maximum number applications	Minimum interval between applications (days)	Pre-harvest interval (days)	Before sowing	From emergence to harvest
Group 3 - Pyrethroids							
Alpha cypermethrin	Lettuce	12	4	14	14		
Pyrethrin	Lettuce	75-100	/	/	2		
Lambda cyhalothrin	Lettuce and spinach	20	2	15	3		
Deltamethrin	Lettuce	7,5	4	14	7		
Bifentrin	Lettuce	40	/	/	/		
Group 1 – Organophosphates and carbamates							
Pirimiphos methyl	/	/	/	/	/	.	
Group 18 – Ecdysone aganists/moulting disruptors							
Azadirachtin	All crops	15-60	No limit	7	2		

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL.
/ elements of the recommended GAP not available

Caterpillars (Army worms, boll worms and other caterpillar species)

Strategy : Scout at least once per week, crop young crops completely with fleece/netting, use pesticides with short PHIs as crop is short term. Target small larvae which are easier to control with insecticides.

Active substance	Recommended GAP*					Proposed application period	
	Crop	Dose g/ha	Maximum number applications	Minimum interval between applications (days)	Pre-harvest interval (days)	Before sowing	From emergence to harvest
Group 3 - Pyrethroids							
Alpha-cypermethrin	Lettuce	12	4	14	14		
Bifenthrin	/	/	/	/	/		
Deltamethrin	Lettuce and spinach	7,5	4	14	7		
Gamma-cyhalothrin	/	/	/	/	/		
Lambda-cyhalothrin	Lettuce and spinach	20	2	15	3		
Pyrethrin	Lettuce	75-100	/	/	2		
Group 5 - Spynosines							
Spinosad	Lettuce	96-216	3	14	3		
	Spinach	96	3	7	3		
Group 11 – Microbial disruptors of insect midgut membranes							
Bacillus thuringiensis var kurstaki	All crops	/	No restriction	7	2		
Group 18 – Ecdysone aganists / moulting disruptors							
Methoxyfenozide	Lettuce and spinach	/	/	/	30		
Indoxacarbe	Lettuce	375	6	7	2		
	Spinach	375	3	14	10		

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL.
/ elements of the recommended GAP not available

Leaf miner fly - *Liriomyza* spp.

Strategy : scout at least once per week, use sticky traps as monitoring, use pesticides with short PHIs as crop is short term.

Active substance	Recommended GAP*					Proposed application period	
	Crop	Dose g/ha	Maximum number applications	Minimum interval between applications (days)	Pre-harvest interval (days)	Before sowing	From emergence to harvest
Group 6 - Avermectins							
Abamectin	Lettuce	21,6	2	7	14		
Group 1 – Organophosphates and carbamates							
Methomyl	Lettuce	250-450	2	14	21		
	Spinach	250-450	1	n.a.	35		
Group 17							
Cyromazine	Lettuce	300	2	7	2		
Group 4 – Nicotinic Acethylcholine receptor agonists / antagonists							
Thiocyclam hydrogenoxalate	All crops	500	3	7	7		

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL.
/ elements of the recommended GAP not available
n.a. : not applicable

Thrips – *Frankliniella* spp.

Strategy : scout at least once per week, use sticky traps as monitoring and mass trapping, crop young crops completely with fleece/netting, use pesticides with short PHIs as crop is short term. Many thrips population, particularly western flower thrips, are resistant to some insecticides and adequate control is often difficult to achieve. PPP spraying should be used when thrips population is extremely high or product contamination is of concern.

Active substance	Recommended GAP*					Proposed application period	
	Crop	Dose g/ha	Maximum number applications	Minimum interval between applications (days)	Pre-harvest interval (days)	Before sowing	From emergence to harvest
Group 3 - Pyrethroids							
Alpha cypermethrin	Lettuce	12	4	14	14		
Gamma-cyhalothrin	/	/	/	/	/		
Garlic and pyrethrins	All crops	347 garlic and 10 pyrethrins	5	7	2		
Lambda cyhalothrin	Lettuce and spinach	20	2	15	3		
Pyrethrin	All crops	40	5	7	2		
Deltamethrin	Lettuce and spinach	7,5	4	14	7		
Group 1 – Organophosphates and carbamates							
Acephate	All crops	375	3	15	21		
Methomyl	Lettuce	250-450	2	14	21		
	Spinach	250-450	1	n.a.	35		
Group 5 - Spynosines							
Spinosad	Lettuce	96-216	3	14	3		
	Spinach	96	3	7	3		
Group 4 – Nicotinic Acethylcholine receptor agonists / antagonists							
Imidacloprid	/	/	/	/	/		
Thiocyclam hydrogenoxalate	All crops	500	3	7	7		

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL.
/ elements of the recommended GAP not available
n.a. : not applicable

Flea beetles - *Phyllotreta* spp.

Strategy : scout at least once per week, use pesticides with short PHIs as crop is short term when problem first seen.

Active substance	Recommended GAP*					Proposed application period	
	Crop	Dose g/ha	Maximum number applications	Minimum interval between applications (days)	Pre-harvest interval (days)	Before sowing	From emergence to harvest
Group 3 - Pyrethroids							
Alpha cypermethrin	Lettuce	12	4	14	14		
Deltamethrin	Lettuce and spinach	7,5	4	14	7		
Lambda cyhalothrin	Lettuce and spinach	20	2	15	3		
Pyrethrin	Lettuce	75-100	/	/	2		

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL.
/ elements of the recommended GAP not available

Powdery mildew – *Erysiphe cichoracearum*

Strategy : scout at least once per week, use pesticides with short PHIs as crop is short term when problem first seen. Application of sulphur to leaf surface before the onset of disease when environmental conditions are favourable can effectively inhibit disease development.

Active substance	Recommended GAP*					Proposed application period	
	Crop	Dose g/ha	Maximum number applications	Minimum interval between applications (days)	Pre-harvest interval (days)	Before sowing	From emergence to harvest
Group 3 : DMI - fungicides							
Mycobutanil	/	/	/	/	/		
Bitertanol	/	/	/	/	/		
Triademefon Triadiménol	/	/	/	/	/		
Group M : Activité multisite							
Sulfur	/	/	/	/	/		
Group 11 : QoI fungicides							
Pyraclostrobin	Lettuce	/	/	/	14		
Group 7 : carboximides							
Boscalid	Lettuce	/	/	/	14		

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL.
/ elements of the recommended GAP not available

Downy Mildew - *Bremia lactucae*

Strategy : timely application of fungicides when environmental conditions are favourable can effectively suppress disease development. Application must start before the appearance of diseases symptoms.

Active substance	Recommended GAP*					Proposed application period	
	Crop	Dose g/ha	Maximum number applications	Minimum interval between applications (days)	Pre-harvest interval (days)	Before sowing	From emergence to harvest
Group 33 : Phosphonates							
Fosetyl aluminium	Lettuce	3000	3	10	14		
Group M : Multisite activity							
Copper	/	/	/	/	/		
Mancozeb	Lettuce	1600	4	7	28		
	Brassica spp.	1600	4	7	30		
Maneb	/	/	/	/	/		
Propineb	Lettuce	2000	2	7	7		
Group 28 : Carbamates							
Propamocarb hydrochloride	/	/	/	/	/		
Group 11 : QoI fungicides							
Azoxytrobin	Lettuce	250	3	10	7		
	Spinach	250	1	n.a.	7		
Trifloxystrobin	/	/	/	/	/		
Group 4 : PhenylAmide fungicides							
Metalaxyl-M	Lettuce	/	3	10	10		Foliar
	Lettuce	/	2	25	14		Soil
	Spinach	/	3	10	20		
Group 3 : DMI - fungicides							
Difenoconazole	Lettuce	175	3	10	7		

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL.
/ : elements of the recommended GAP not available
n.a. : not applicable

White mould - *Sclerotinia sclerotiorum*

Strategy : apply fungicides promptly after thinning.

Active substance	Recommended GAP*					Proposed application period	
	Crop	Dose g/ha	Maximum number applications	Minimum interval between applications (days)	Pre-harvest interval (days)	Before sowing	From emergence to harvest
Group 11 : QoI fungicides							
Azoxytrobin	Lettuce	250	3	10	7		
Pyraclostrobin	Lettuce	/	/	/	14		
Group 2 : dicarboximides							
Iprodione	Lettuce	750	2	/	7		
Group M : Multisite activity							
Thiram	Lettuce	2000	/	/	21		
Group 9 : AP fungicides							
Pyrimethanil	Lettuce	800	2	10	14		
Group 7 : carboximides							
Boscalid	Lettuce	400	2	7	14		

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL.
/ elements of the recommended GAP not available

Damping off - *Pythium* spp. *Rhizoctonia solani, Fusarium* spp.

Strategy : if disease has been severe in the past, consider application of one of the following fungicides to seedlings.

Active substance	Recommended GAP*					Proposed application period	
	Crop	Dose g/ha	Maximum number applications	Minimum interval between applications (days)	Pre-harvest interval (days)	Before sowing	From emergence to harvest
Group M : Multisite contact activity							
Mancozeb 640+metalaxyl-M 40	Lettuce	/	/	/	14		
	Brassica spp.	/	/	/	30		
Captan	/	/	/	/	/		
Carboxine + thiram	All crops	50/100 kg seed	1	n.a.	n.a.		
Group 28 : carbamates							
Propamocarbe hydrochloride	Lettuce	/	/	/	14		

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL.
/ : elements of the recommended GAP not available
n.a. : not applicable

Leaf spot - *Xanthomonas* spp.

Strategy : copper fungicides can be used, but are not very effective; they must be applied before infection occurs.

Active substance	Recommended GAP*					Proposed application period	
	Crop	Dose g/ha	Maximum number applications	Minimum interval between applications (days)	Pre-harvest interval (days)	Before sowing	From emergence to harvest
Group M : Multisite contact activity							
Copper	Lettuce	/	/	/	14		

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL.
/ elements of the recommended GAP not available.

5. Existing registrations

Remarks : This information should be tallied with the legislation in force locally in each area of production.

Registration of insecticides in Kenya.

Active substance	Crops
abamectin	vegetables
acephate	vegetables
azadirachtin	agricultural crops
Bacillus thuringiensis var *kurstaki*	vegetables
bifenthrin	vegetables
cypermethrin	vegetables
deltamethrin	vegetables
dimethoate	vegetables
gamma - cyhalothrin	vegetables
lambda - cyhalothrin	vegetables
methomyl	vegetables
pirimicarb	vegetables
pirimiphos méthyl	vegetables
pymetrozine	vegetables
pyrethrins	vegetables
spinosad	vegetables
thiamethoxam	vegetables

Registration of fungicides in Kenya

Activesubstance	Crops
copper	vegetables
fosetyl aluminium	lettuce
iprodione	vegetables
mancozeb	lettuce
metalaxyl-M + mancozeb	vegetables
propineb	vegetables
sulphur	vegetables
thiophanate methyl	vegetables
tebuconazole	vegetables
triademefon	vegetables

6. European regulations and pesticide residues

Caution : The information contained in this table is subject to change by future directives of the Commission of the European Communities. Tha data were updated in June 2009.

MRL for lettuce and other similar crops* in Europe		
Active substance	**Statuts DIR 91/414**	**European MRL**
Abamectin	Annex 1	0.1[1]
Acephate	Withdrawn	0.02[1]
Acetamiprid	Annex 1	5[2,3,5] 0.01[4,6]
Alpha-cypermethrin	Annex 1	2[1]
Azadirachtin	Not included**	1[1]
Azoxystrobin	Annex 1	3[1]
Bacillus thuringiensis	Annex 1	/
Bifenthrin	Notified List 3a	2[1]
Bitertanol	Not included**	0.05[1]
Boscalid	Annex 1	10[2,3,4,5,6]
Captan	Annex 1	0.02[2,3,4,5,6]
Carboxin	Not included**	0.05[2] 0.5[3,6] 0.1[4,5]
Chlorpyriphos-ethyl	Annex 1	0.05[1]
Copper	Annex 1	100[1]
Cypermethrin	Annex 1	2[1]
Cyromazine	Annex 1	15[2,3,6] 0.05[4,5]
Deltamethrin	Annex 1	0.5[1]
Difenoconazole	Annex 1	3[2] 2[3] 0.05[4,5,6]
Dimethoate	Annex 1	0.5[2] 0.02[3,4,5,6]
Fosetyl-Al	Annex 1	75[1]
Gamma-cyhalothrin	Pending	0.01[1]
Imidacloprid	Annex 1	2[2,3,4,5,6]

* MRLs indicated in this table are valid for following crops:
[1] : all lettuces and other salad plants including *Brassicae* [2] : lettuce (lollo rosso ...) [3] : rocket, wild rocket [4] : red mustard
[5] : leaves and sprouts of *Brassica* spp. [6] : others salad plants
**Not included in Annex 1 for the time being and the EU Member States have the possibility to maintain authorisations until 31 December 2010

MRL for lettuce and other similar crops* in Europe (continued)		
Active substance	**Statuts DIR 91/414**	**European MRL**
Indoxacarbe	Annex 1	2[2] 0.02[3,4,6] 1[5]
Iprodione	Annex 1	10[1]
Lambda-cyhalothrin	Annex 1	0.5 [2] 1[3,4,5,6]
Mancozeb and maneb	Annex 1	5[1]
Metalaxyl-M	Annex 1	2 [2,3,5] 0.05[4,6]
Methomyl	Annex 1	0.3[2] 0.05[3,4,5,6]
Methoxyfenozide	Annex 1	0.02[1]
Myclobutanil	Not included**	0.02[2,3,4,5,6]
Pirimicarb	Annex 1	5[1]
Pirimiphos-methyl	Annex 1	0.05[1]
Propamocarb HCl	Annex 1	50[2] 20[3,4,5,6]
Propineb	Annex 1	0.05[2,4,5,6] 5[3]
Pymetrozine	Annex 1	2[1]
Pyraclostrobine	Annex 1	2[2,3,4,5,6]
Pyrethrins	Annex 1	1[1]
Pyrimethanil	Annex 1	10[2] 0.05[3,4,5,6]
Rotenone	Withdrawn	0.01[1]
Spinosad	Annex 1	10[1]
Sulfur	Annex 1	50[1]
Tau-fluvalinate	Not included**	0.3[2,3,4,5,6]
Thiacloprid	Annex 1	2[2,4,5,6] 3[3]
Thiocyclam	Withdrawn	0.01[1]
Thiram	Annex 1	2[2] 0.1[3,4,5,6]
Triadimefon	Withdrawn	0.1[1]
Triadimenol	Annex 1	0.1[1]
Trifloxystrobin	Annex 1	0.02[1]

* MRLs indicated in this table are valid for following crops:
[1] : all lettuces and other salad plants including *Brassicae* [2] : lettuce (lollo rosso ...) [3] : rocket, wild rocket [4] : red mustard
[5] : leaves and sprouts of *Brassica* spp. [6] : others salad plants
**Not included in Annex 1 for the time being and the EU Member States have the possibility to maintain authorisations until 31 December 2010

MRL for spinach and other similar crops* in Europe		
Active substance	Statuts DIR 91/414	European MRL
Abamectin	Annex 1	0.01[1]
Acephate	Withdrawn	0.02[1]
Acetamiprid	Annex 1	0.01[1]
Alpha-cypermethrin	Annex 1	0.5[1]
Azadirachtin	Not included**	1[1]
Azoxystrobin	Annex 1	0.05[1]
Bacillus thuringiensis	Annex 1	/
Bifenthrin	Notified List 3a	0.05[2,3]
Bitertanol	Not included**	0.05[1]
Boscalid	Annex 1	10[2] 0.5[3]
Captan	Annex 1	0.1[2] 0.02[3]
Carboxin	Not included	0.5[2] 0.1[3]
Chlorpyriphos-ethyl	Annex 1	0.05[1]
Copper	Annex 1	20[1]
Cypermethrin	Annex 1	0.5[1]
Cyromazine	Annex 1	0.05[2,3]
Deltamethrin	Annex 1	0.5[1]
Difenoconazole	Annex 1	2[2] 0.05[3]
Dimethoate	Annex 1	0.02[1]
Fosetyl-Al	Annex 1	75[2] 2[3]
Gamma-cyhalothrin	Pending	0.01[1]
Imidacloprid	Annex 1	0.05[1]
Indoxacarb	Annex 1	2[2] 0.02[3]
Iprodione	Annex 1	0.02[2,3]
Lambda-cyhalothrin	Annex 1	0.5[1]
Mancozeb and Maneb	Annex 1	0.05[2,3]
Metalaxyl-M	Annex 1	0.05[2,3]
Methomyl	Annex 1	0.01[1]
Methoxyfenozide	Annex 1	0.02[1]
Myclobutanil	Not included**	0.02[1]
Petrol oil	Notified List 4h	/
Prochloraz	Not included**	0.05[2,3]

* MRLs indicated in this table are valid for following crops:
1 - Spinach and similar with included *Spinacia oleracea* and *Basella alba*
2 - Spinach *Spinacia oleracea*
3 - Others similar

**Not included in Annex 1 for the time being and the EU Member States have the possibility to maintain authorisations until 31 December 2010

MRL for spinach and other similar crops* in Europe		
Active substance	Statuts DIR 91/414	European MRL
Propamocarb HCl	Annex 1	30[2] 10[3]
Propineb	Annex 1	0.05[1]
Pymetrozine	Annex 1	0.02[1]
Pyraclostrobine	Annex 1	0.5[2,3]
Pyrethrins	Annex 1	1[1]
Pirimicarb	Annex 1	2[2] 5[3]
Pirimiphos-methyl	Annex 1	0.05[1]
Pyrimethanil	Annex 1	0.05[1]
Rotenone	Withdrawn	0.01[1]
Spinosad	Annex 1	10[1]
Sulphur	Annex 1	50[1]
Tau-fluvalinate	Not included**	0.01[1]
Thiacloprid	Annex 1	0.02[1]
Thiocyclam	Withdrawn	0.01[1]
Thiophanate-methyl	Annex 1	0.1[1]
Thiram	Annex 1	0.1[1]
Triadimefon	Withdrawn	0.1[1]
Triadimenol	Annex 1	0.1[1]
Trifloxystrobin	Annex 1	0.02[1]

* MRLs indicated in this table are valid for following crops:
1 - Spinach and similar with included *Spinacia oleracea* and *Basella alba*
2 - Spinach *Spinacia oleracea*
3 - Others similar

**Not included in Annex 1 for the time being and the EU Member States have the possibility to maintain authorisations until 31 December 2010

Note on the European MRL harmonisation:

The DG Health and Consumers (DG SANCO) has undertaken an MRL harmonisation process on the European level and has established a new EC MRL regime under EC Regulation 396/2005 and its annexes, which was published afterward as separate Regulations.

A list of national MRL was gathered by DG SANCO in June 2005 and submitted to EFSA (European Food Safety Authority) for verification and approval.

When no specific MRL exists for a crop, a default MRL is set at 0,01 mg/kg. These default EU MRLs as well as the EU MRLs based on measured residues could only be set after the publication of Annex I to the Regulation, establishing the list of food and feed products (Regulation (EC) No 178/2006 of 1st February 2006).

Towards the end of 2007 EFSA submitted the conclusion report of the MRL evaluation and recommendation to the Commission for final decision on the setting of harmonised EU MRLs.

These EU MRLs are listed in the annexes ,II,III and IV of the EC Regulation which were established by the Regulation (EC) No 149/2008 of 29 January 2008. The annexes were updated for the first time in March 2008 and the MRLs were entered into force on September 1st, 2008 and are available on the website http://ec.europa.eu/sanco_pesticides/public/index.cfm

Annexes

1. References websites and useful documents

Gratwick, M. (Edit) (1992). Crop pests in the UK. Chapman and Hall, London.

Malais, M.H. and Ravensburg, W.J. (2003). Knowing and Recognising. Koppert Biological Systems, Reed Business Information, The Netherlands.

Ryder, E.J. (1999). Lettuce, Endive and Chicory. CABI Publishing, Wallingford, UK

OEPP/EPPO (1994) (Rev 2000). PP 2/3(2) (English) Guidelines on good plant protection practice, Lettuce under protected cultivation

OEPP/EPPO (1994) EPPO Standard PP 2/1(1) Guideline on good plant protection practice : principles of good plant protection practice. *Bulletin OEPP/EPPO Bulletin* 24, 233-240.

Integrated Pest Management for Cole Crops and Lettuce. Publication 3307. University of California.- 112 pages

Maladies des salades – identifier, connaître et maîtriser : Dominique Blancard, Hervé Lot, Brigitte Maisonneuve - INRA

2. Useful Websites

Lettuce. UC IPM Pest Management Guidelines–University of California's http ://www.ipm.ucdavis.edu/PMG/selectnewpest.lettuce.html

CROP PRODUCTION PROTOCOLS

Avocado (*Persea americana*)
French bean (*Phaseolus vulgaris*)
Okra (*Abelmoschus esculentus*)
Passion fruit (*Passiflora edulis*)
Pineapple Cayenne (*Ananas comosus*)
Pineapple MD2 (*Ananas comosus*)
Mango (*Mangifera indica*)
Papaya (*Carica papaya*)
Pea (*Pisum sativum*)
Cherry tomato (*Lycopersicon esculentum*)

GUIDES TO GOOD PLANT PROTECTION PRACTICES

Amaranth (*Amaranthus* spp.)
Baby carrot (*Daucus carota*)
Baby and sweet corn (*Zea mayis*)
Baby Leek (*Allium porrum*)
Baby pak choy (*Brassica campestris* var. *chinensis*), baby cauliflower (*Brassica oleracea* var. *botrytis*), baby broccoli and sprouting broccoli (*Brassica oleracea* var. *italica*) *and head cabbages* (*Brassica oleracea var. capitata* and *var. sabauda*)
Banana (*Musa* spp. – plantain (*matoke*), apple banana, red banana, baby banana and other ethnics bananas)
Cassava (*Manihot esculenta*)
Chillies (*Capsicum frutescens, Capsicum annuum, Capsicum chinense*) and sweet peppers (*Capsicum annuum*)
Citrus (*Citrus* sp.)
Coconut (*Cocus nucifera*)
Cucumber (*Cucumis sativus*), zucchini and pattypan (*Cucurbita pepo*) and other cucurbitaceae with edible peel of the genus *Momordica, Benincasa, Luffa, Lagenaria, Trichosanthes, Sechium* and *Coccinia*
Dasheen (*Colocasia esculenta*) and macabo (*Xanthosoma sagittifolium*)
Eggplants (*Solanum melongena*, *Solanum aethiopicum*, *Solanum macrocarpon)*
Garlic, onions, shallots (*Allium sativum, Allium cepa, Allium ascalonicum*)
Ginger (*Zingiber officinale*)
Guava (*Psidium catteyanum*)
Lettuce *(Lactuca sativa*), spinach (*Spinacia oleracea* and *Basella alba*), leafy brassica (*Brassica* spp.)
Lychee (*Litchi chinensis*)
Melon (*Cucumis melo*)
Organic Avocado (*Persea americana*)
Organic Mango (*Mangifera indica*)
Organic Papaya (*Carica papaya*)
Organic Pineapple (*Ananas comosus*)
Potato (*Solanum tuberosum*)
Sweet potato (*Ipomea batatas*)
Tamarillo (*Solanum betaceum*)
Water melon (*Citrullus lanatus*) and butternut (*Cucurbita moschata*)
Yam (*Dioscorea* spp.)

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