

PIP



GUIDE TO GOOD CROP PROTECTION PRACTICES

FOR 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*)

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www.coleacp.org/pip



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FOR SUSTAINABLE DEVELOPMENT OF
THE ACP HORTICULTURAL INDUSTRY

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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

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1. Main pests and diseases

1.1 Extent and impact on the quantity and quality of fruit 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: + = low, ++ = average, +++ = high;
- the parts of the plant affected and how they are attacked;
- the resulting types of loss, all of which decrease the yield of marketable fruit 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 or flower heads per plant, smaller-sized leaves or flower heads, lower quality of leaves or flower heads.

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

INSECTS					
Extent	Organs attacked		Types of loss		
	Leaves	Flower heads	Number of plants	Size of plants	Quality of leaves or flower heads at maturity
Diamond black moth - <i>Plutella xylostella</i>					
+++	Eaten by larvae		Death of plants by early damage	Reduced if heavy infestation at early stage	Reduced by window feeding of young larvae; hole feeding of older larvae and excrement deposition
Aphids, e.g. cabbage aphids - <i>Aphis</i> spp. - Cabbage Aphid <i>Brevicoryne brassicae</i>					
Vector for various viruses					
+++	Bitten into by adults and larvae		Death of heavy infested plants	Stunted growth	Reduced by leaf curling, honey dew and sooty moulds
Mustard saw fly - <i>Athalia lugens subsp. proxima</i>					
++	Eaten by larvae		Plant death exceptionally	Reduced if heavy infestation at early stage	Reduced for leaves by skeleton feeding
Leaf miner fly - <i>Liriomyza</i> spp. QO					
++	Bitten into by adults and mined by larvae		Sometimes death of plant	Seedling weakness	Loss of quality for leaves due to puncture marks and mines
Black Cut worm - <i>Agrotis ipsilon</i>					
++	Leaves and/or stem are eaten by caterpillars		Severance of plants near the soil line, cutting of seedlings Young plants can be killed		

INSECTES (continued)

Extent	Organs attacked		Types of loss		
	Leaves	Flower heads	Number of plants	Size of plants	Quality of leaves or flower heads at maturity
White fly <i>Bemisia tabaci</i> - <i>Trialeurodes vaporariorum</i> - <i>Aleurodes brassica</i> (Cabbage white fly)					
+	Bitten into by adults and larvae		Plant wilt, turned yellow and died		Reduced for leaves due to honey dew that encourages sooty mould growth
Thrips <i>Frankliniella</i> spp. <i>Frankliniella occidentalis</i> Q0 - <i>Thrips palmi</i> Q0					
+	Eaten by adults and larvae			Significant reduction if growth is slowed by severe attacks on young plants particularly in hot weather	Quality reduction by leave distortion
Flea beetle - <i>Phyllotreta</i> spp.					
+	Puncture by adults		Death of plants if seedlings attacked		Yield losses, because of unmarketable crops
Cabbage moth - <i>Crociodolomia binotalis</i>					
+++	Chewed off				Affected plants are soiled with excrements of larvae. Crop is unmarketable
FUNGI					
Extent	Organs attacked		Types of loss		
	Leaves	Flower heads	Number of plants	Size of plants	Quality of leaves or flower heads at maturity
Black leg - <i>Phoma lingam</i>					
++	Mycelium develop in the stem and on leaves It can be seedborne		Death of plants	Stunting and wilt	Reduced for leaves by presence of circular and inconspicuous spots, grey in colour
Downy mildew - <i>Peronospora parasitica</i>					
+++	Mycelium develop on the lower surface of leaves and stem		Seedlings can be killed	Reduced by defoliation of plants	Reduces quality and yield by reduced and unsightly foliage.

FUNGI (continued)					
Extent	Organs attacked		Types of loss		
	Leaves	Flower heads	Number of plants	Size of plants	Quality of leaves or flower heads at maturity
Fusarium yellows - <i>Fusarium oxysporum</i> f.sp. <i>conglutinans</i>					
++	Enter through young rootlets or wounds on older roots		Death of seedlings	Premature leaf fall reduce size	Reduction of quality and marketability for leaves
Damping off - <i>Rhizoctonia solani</i> and <i>Pythium</i> spp.					
++	Soilborne disease that attack stem		Death of seedlings or young transplants Infected seeds decay in the soil	Reduced by shrivelling of the stem. Stunted or wilted plant	
Alternaria leaf spot - <i>Alternaria brassicae</i>					
++	Develop on whole plant		Death of seedlings or young plants		Loss of quality and marketability by presence of spots on leaves and flower heads
Powdery mildew - <i>Erysiphe polygoni</i> and <i>E. cruciferarum</i>					
++	Mycelium develop on lower and upper face of leaves				Loss of quality and marketability by unsightly leaves
White rust - <i>Albugo candida</i>					
+	Develop on both upper and lower side of the leaves. Stems and flower heads could be affected also.		Death of plants can occur in severe cases	Reduction by leaves drop	Leaf malformation Flower heads can be affected also post-harvest
<i>Mycosphaerella</i> ring spots - <i>Mycosphaerella brassicicola</i>					
++	Develop on leaves and stem			Reduced when defoliation occur severely	Leaf malformation Disease can develop post-harvest.
Club root - <i>Plasmodiophora brassicae</i>					
+	This soilborne disease enter through roots		Death of plants	Stunting	

BACTERIA					
Extent	Organs attacked		Types of loss		
	Leaves	Flower heads	Number of plants	Size of plants	Quality of leaves or flower heads at maturity
Bacterial black rot - <i>Xanthomonas campestris</i> pv. <i>campestris</i>					
++	Enter through above-ground parts of the plant or seeds		Death of seedlings if infected seeds		Appearance make crop unmarketable Whole heads can turn black
Bacterial soft rot - <i>Pseudomonas</i> spp. and <i>Erwinia</i> spp.					
++	Enter in the plant through wounds				Appearance make crop unmarketable A soft rot which decays the heads in wet weather Post harvest, but also in the field
VIRUSES					
Extent	Organs attacked		Types of loss		
	Leaves	Flower heads	Number of plants	Size of plants	Quality of leaves or flower heads at maturity
Mosaic virus - Cauliflower Mosaic Virus; Turnip Mosaic Virus					
Transmitted by aphids					
++	Spread in the whole plant after transmission by aphids			In leafy <i>brassicac</i> s plants become stunted	Appearance makes crop unmarketable

1.2. Identification and damage

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

INSECTS

Diamond black moth - *Plutella xylostella*

A small grey-brown moth about 8 mm in length. Eggs are small, white and flat and live singly or in groups on the upper side of the leaf. Larvae are pale green and pupae seen on the underside of leaves. Young larvae eat leaves causing windowing, whilst older larvae cut holes and excrement deposited by larvae often seen.



Caterpillar



Chrysalide



Adult

Aphids (*Aphis* spp) e.g. Cabbage Aphid (*Brevicoryne brassicae*)

Distributed in colonies, both as wingless and winged forms. Grey-greenish in colour, they are covered in a grey waxy powder covering, hence the alternative name of grey aphid. In large colonies causes leaf curl, discoloration stunted growth and even death of infested plants. Sooty moulds seen from excretion of honey dew.



Colonies of *Brevicoryne brassicae*

Saw fly - *Athalia lugens* subsp. *proxima*

The adults are wasps, with a dark head and thorax; and an abdomen that is yellow. Eggs are laid in the leaf and larvae are black/green and appeared humped as they have a swollen part behind the head. They are similar to caterpillars except they have more prolegs (6 – 9) compared to the caterpillar which as 3 – 5. Eat leaves causing skeleton and often only the main veins remain.



Adult

Leaf miner fly - *Liriomyza* spp.

Adults are small flies, shiny body and depending on the species a yellow spot on the back of the abdomen. Larvae cause irregular leaf mines. Pupation occurs on the upper side of the leaf or on the ground. Feeding puncture marks on leaves and the mines are very visible signs of leaf miner attack. Heavy attack on seedling weakens the plant.



Mines on a leaf

Black cutworm - *Agrotis ipsilon*

Leaf feeding by cutworms usually occurs before cutting is observed. The larvae sever plants near the soil line. After cutting a seedling, the black cutworm commonly pulls it into the entrance of its burrow and feeds on it during the day.



Young plant cut by cutworm

White fly - *Aleurodes brassica* (Cabbage white fly); and *Bemisia tabaci*; *Trialeurodes vaporariorum*

White fly is an insect about 1-3 mm long with two pairs of wings and a pair white or cream in colour. Found in groups on the underside of the leaf. Eggs are laid on the underside of the leaf and rise vertically from the leaf in arcs or groups. The first nymphal instar is the crawler and can move around the leaf whilst other instars are fixed as scales on the leaf surface. Damage is mainly with the excretion of honeydew that encourages sooty mould growth.



Adults



Larvae

Thrips - *Frankliniella* spp. and *Thrips palmi*

Adults are thin and winged insects about 1 mm in length. Eggs are laid in the leaf tissue and the larvae are pale green/yellow in colour and found as wingless larvae on the leaf surface. Damage is by single puncture feeding marks by the adult or by rasping under leaf damage.



Larva



Damages

Flea beetle - *Phyllotreta* spp.

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



Adults on damaged leaves



Cabbage moth - *Crocidolomia binotalis*

Light brown moths with a 18 - 23 mm wing span. Eggs are laid in groups, furry in appearance. Larva is dark green in colour with a light brown head. The young larvae feed on the top of the leaf blade and older larvae can be covered with a silken web and plenty of excrement is visible.



Damaged cauliflower



Caterpillars

FUNGI

Black Leg - *Phoma lingam*

Circular and inconspicuous spots, grey in colour. Black dots (fruiting bodies (pycnidia) develop in spot centre. On the stems, light brown elongated areas with purple margins develop near the soil surface. These margins girdle the stem and turn black, hence the name black leg. Affected plants will wilt and die.

Downy mildew - *Peronospora parasitica*

A pale grey or whitish mycelium found on the underside of leaves, most visible in wet conditions. Later pale yellow spots are seen on the top of the leaf. Seen in all ages of plant and can cause defoliation.



Symptoms on leaves

Yellows - *Fusarium oxysporum* f.sp. *conglutinans*

Loss of vigour and yellow lower leaves. Premature leaf fall and cross sections of stems show discolouration which is pale reddish brown.



Symptoms on a leaf

Damping off - *Rhizoctonia solani* and *Pythium* spp.

Death, wilting or stunting of seedlings. For *Rhizoctonia*, typical is the shrivelling of the stem which leaves a dark wire like stem, hence the name "wirestem" and results in stunted plantlet. Less common is infection later in the plants life with root rots and head rots that can be firm or slimy. Secondary bacterial soft rot can then set in.



Pythium

Club root - *Plasmodiophora brassicae*

First sign is the slow growth and wilting of the plant. Examining the roots reveals malformations, swellings and galls. Affects all brassicas.



Symptoms on the roots

Alternaria* leaf spot – *Alternaria brassicae

Very small spots on seedling leaves and can cause death in the see bed. In larger plants leaf spotting, often on lower leaves. The spots are brown or black in colour; circular and have concentric rings or zones.



Symptoms on leaves

Powdery mildew – *Erysiphe polygoni* and *E. cruciferarum*

Circular white spots with a powder like deposit on underside of leaves that later form on the upper side. Leaves which are badly affected turn brown and can prematurely drop off.



Symptoms

White rust – *Albugo candida*

Raise yellow-green spots develop on the upper side of the leaves. They develop on both sides of the leaf and rupture on the lower side of the leaf revealing masses of white powdery spores in small cavities. Leaf malformation and death can occur in severe cases. Only a major problem in radish.

Mycosphaerella* ring spot – *Mycosphaerella brassicicola

Seen mainly on older leaves as brown-grey spots up to 20 mm in diameter. Spots have concentric rings. When veins affected leaf distortion occurs and defoliation occurs when severe. Disease can develop post-harvest.

BACTERIA

Bacterial Black Rot - *Xanthomonas campestris* pv. *campestris*

Early damage is seen on the margins of leaves, with yellow “V” areas moving into the leaf from the leaf edge. The yellow will progressively have black dots. Whole heads can turn black and cross sections of petioles show black rings. In wet weather soft rot bacteria can develop in black rot tissue.



Symptom on head cabbage

Bacterial Soft rot - *Pseudomonas* spp. and *Erwinia* spp.

A soft rot which decays the heads in wet weather. An offensive odour is associated with the bacteria. Bacterial slime can sometimes be seen. A disease often seen post-harvest but can occur in the field. Often a disease which is a secondary infection following another initial disease attack.



VIRUSES

Mosaic Viruses - Cauliflower Mosaic Virus, Turnip Mosaic Virus

Both viruses cause spotting on either side of the leaf. In leafy *brassic*as, beets and spinach plants become stunted, leaves distorted and premature leaf drop. In cabbages the symptoms develop in store.



Turnip Mosaic Virus: Interveinal chlorosis observed. Leaves will sometime appear puckered and distorted

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

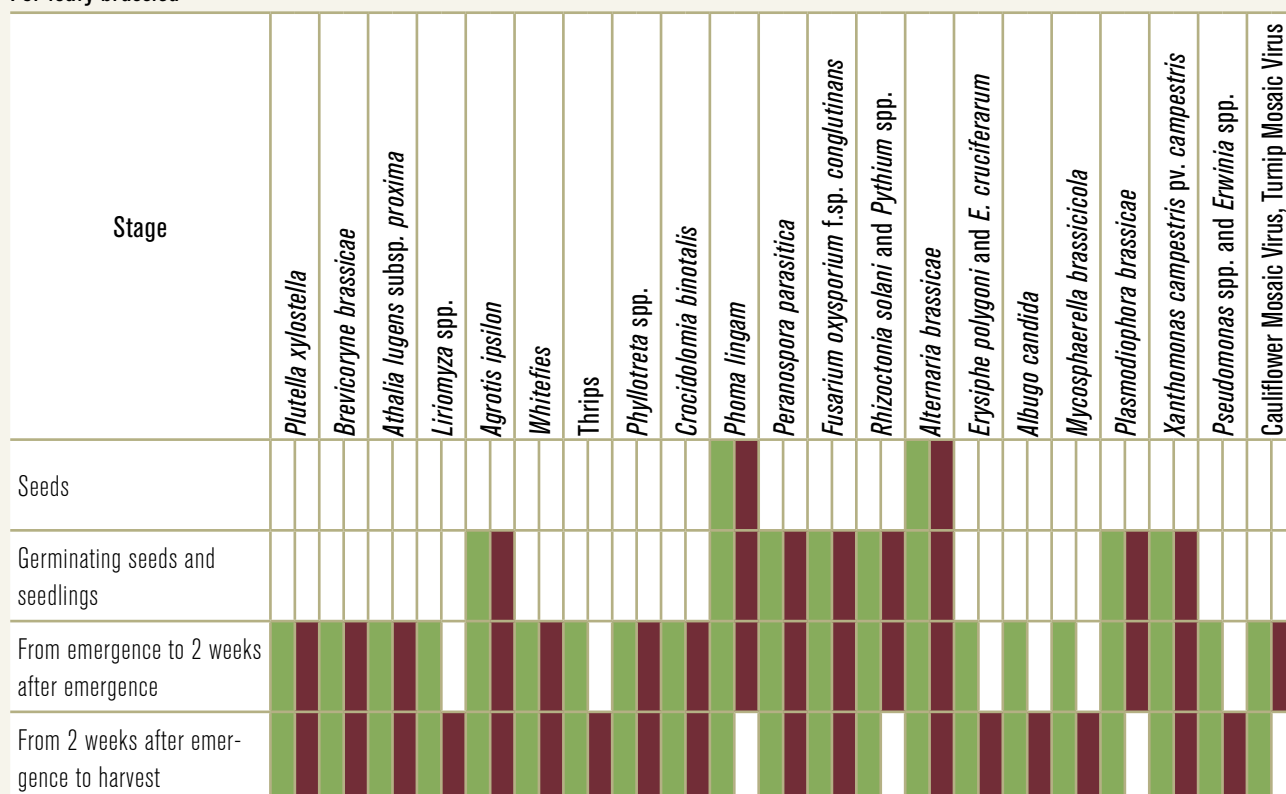
The following table shows the stages of cultivation during which crop enemies are potentially present and the stages during which their presence can do the most harm. It is especially during the latter stages that they must be monitored and controlled if necessary. The purpose is to show that the presence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

For flowering *brassic*a

Stage	<i>Plutella xylostella</i>	<i>Brevicoryne brassicae</i>	<i>Athalia lugens</i> subsp. <i>proxima</i>	<i>Liriomyza</i> spp.	<i>Agrotis ipsilon</i>	Whiteflies	Thrips	<i>Phyllotreta</i> spp.	<i>Crocidolomia binotalis</i>	<i>Phoma lingam</i>	<i>Peronospora parasitica</i>	<i>Fusarium oxysporium</i> f.sp. <i>conglutinans</i>	<i>Rhizoctonia solani</i> and <i>Pythium</i> spp.	<i>Alternaria brassicae</i>	<i>Erysiphe polygoni</i> and <i>E. cruciferarum</i>	<i>Albugo candida</i>	<i>Mycosphaerella brassicicola</i>	<i>Plasmidiophora brassicae</i>	<i>Xanthomonas campestris</i> pv. <i>campestris</i>	<i>Pseudomonas</i> spp. and <i>Erwinia</i> spp.	Cauliflower Mosaic Virus, Turnip Mosaic Virus
Seeds																					
Germinating seeds and seedlings																					
From emergence to 6 weeks after emergence																					
From 6 weeks after emergence to first flowering																					
From first flowering to end of harvesting																					

■ 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

For leafy *brassica*



■ 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

Key:

KEN = Kenya, ZAM = Zambia, and TAN = Tanzania

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 may be present, but has perhaps never been observed in the country on the crop, because it does not cause serious damage.

Diamond black moth - *Plutella xylostella*

Favourable conditions : A serious pest in dry months, rainfall reduces DBM populations and is less of a problem in wet years and months.

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

Aphids e.g. Cabbage Aphid (*Brevicoryne brassicae*)

Favourable conditions : More serious in dry conditions and populations reduced in wet months. Also low in spring and early summer in Zambia.

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

Saw fly - *Athalia lugens* subsp. *proxima*

Favourable conditions : All year round, but characterised by its sporadic attacks, which are difficult to predict or to link to particular climactic factors.

Mois	1	2	3	4	5	6	7	8	9	10	11	12
KEN	+	+	+	+	+	+	+	+	+	+	+	+
ZAM	0	0	+	+	+	+	+	+	+	+	0	0
TAN	++	++	++	+	+	+	++	++	++	++	+	+

Leaf miner fly - *Liriomyza* spp.

Favourable conditions : A pest which is most serious in dry weather, but found all the year round.

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

Black cutworm - *Agrotis ipsilon*

Favourable conditions : Following grassland, moist soil.

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

White fly - *Aleurodes brassica* (Cabbage white fly); and *Bemisia tabaci*; *Trialeurodes vaporariorum*

Favourable conditions : All year round, but during dry weather more serious, though on *brassicacae* not a serious pest.

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

Thrips - *Frankliniella* spp. and *Thrips palmi*

Favourable conditions : In dry weather but can be seen all year round, but not significant on *brassicacae* in wet weather.

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

Flea beetle - *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	+	+	+	0	0	+	+	+	+	+	0	+
ZAM	+	+	0	0	0	0	+	+	+	+	+	+
TAN	+	+	+	0	0	+	+	+	+	+	0	+

Cabbage moth - *Crociodolomia binotalis*

Favourable conditions : A moderate pest in dry months, rainfall reduces populations and is less of a problem in wet years and months.

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

Black Leg - *Phoma lingam*

Favourable conditions : In humid, cool and rainy weather essential.

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

Downy mildew - *Peronospora parasitica*

Favourable conditions : In humid and rainy weather with leaf wetness. Cool night temperatures which do not exceed 24°C favour disease development.

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

Yellows - *Fusarium oxysporum* f.sp. *conglutinans*

Favourable conditions : In humid and rainy weather and over wet soils with poor drainage and warm temperatures

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

Damping off - *Rhizoctonia solani* and *Pythium* spp.

Favourable conditions : In humid and rainy weather, with over wet and poorly drained seedbeds.

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

Alternaria leaf spot – *Alternaria brassicae*

Favourable conditions : In humid and rainy weather, leaf wetness for more than 9 hours and mid range temperatures 22 – 28°C.

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

Powdery mildew – *Erysiphe polygoni* and *E. cruciferarum*

Favourable conditions : Prevalent in humid but no leaf wetness. Warm weather favoured with temperatures about 28°C for spore germination and windy conditions to spread spores.

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

White rust – *Albugo candida*

Favourable conditions : Moist cool weather, and spores spread by rain, wind and insects. Optimum temperature about 20°C

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

Mycosphaerella* ring spot – *Mycosphaerella brassicicola

Favourable conditions : Leaf wetness important for the development of the disease and temperatures around 16 – 22°C.

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

Club root – *Plasmodiophora brassicae*

Favourable conditions : Mainly found in acid soils, that are wet and cool 20 – 24°C.

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

Bacterial Black Rot - *Xanthomonas campestris* pv. *campestris*

Favourable conditions : Mainly seen in humid and rainy weather. Bacterial growth increase with higher temperatures.

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

Bacterial Soft rot - *Pseudomonas* spp. and *Erwinia* spp.

Favourable conditions : In humid and rainy weather and favours opportunity for secondary infection. Bacterial growth increase with higher temperatures.

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

Mosaic Viruses - Cauliflower Mosaic Virus, Turnip Mosaic Virus

Favourable conditions : Found all the year round but most favourable conditions are when vector (aphids) are active which is in drier conditions.

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

2. Main control methods

2.1. Introduction

The control of pests and diseases on baby *brassicaceae* requires an integrated approach with the use of cultural, physical, biological and Plant Protection Products (PPP). The major pests include diamond black moth, aphids, 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

For baby vegetables 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 PPP 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, diamond back moth, thrips; a physical barrier is a valuable method of control.

Rotation

Rotate *brassicaceae* with most other field vegetable crops. The benefits of using *brassicaceae* for other crops is particularly advantageous as this family group is the basis of biofumigant crops that reduce soils diseases like *fusarium* and nematodes.

Tillage

Burial of *brassicaceae* residues, is beneficial in reducing pathogen survival and inoculum for the succeeding crops. The burial of infested debris facilitates rotting and deprives the fungus of a food base. The fungus is unable to survive freely within the soil. It can only overwinter within and on dead *brassicaceae* tissue remaining on or above the soil surface. Disking does not sufficiently bury the infested debris. Mold board plowing 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.

The control methods for pests or diseases whose cycle is not illustrated are presented in a table.

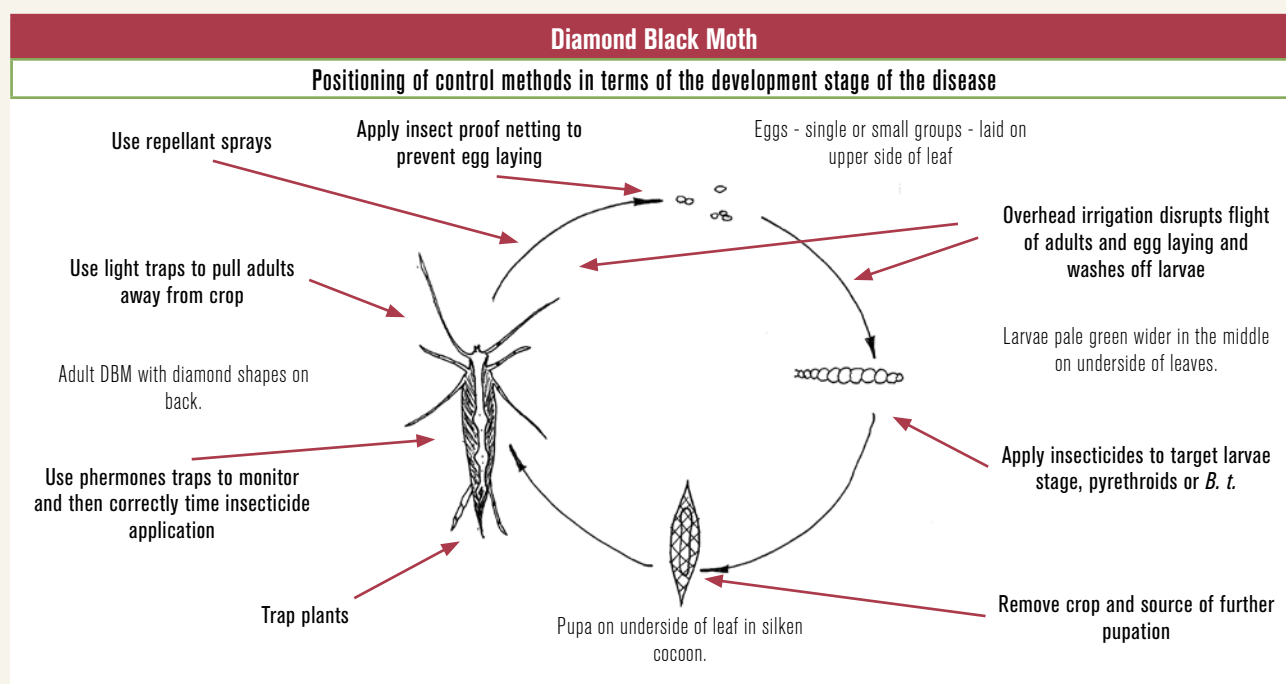
The second column of the table shows what actions should be taken to control the different stages of development of the pest or the disease shown in the first column.

In the second column, actions that can be referred to as "cultivation practices" are shown in green boxes, and actions that can be referred to as "application of plant protection products", in rosé boxes.

■ Cultivation practices

■ Application of plant protection product

The third column shows the cultivation stage during which these actions should be taken.



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

Nursery

- Apply insect proof netting to prevent egg laying.
- Apply pesticides for control of larvae such as pyrethroids or *B. t.*

Field

Field preparation

- Plant trap plants to pull DBM away from crop.

During sensible stage of the plant (see 1.3.)

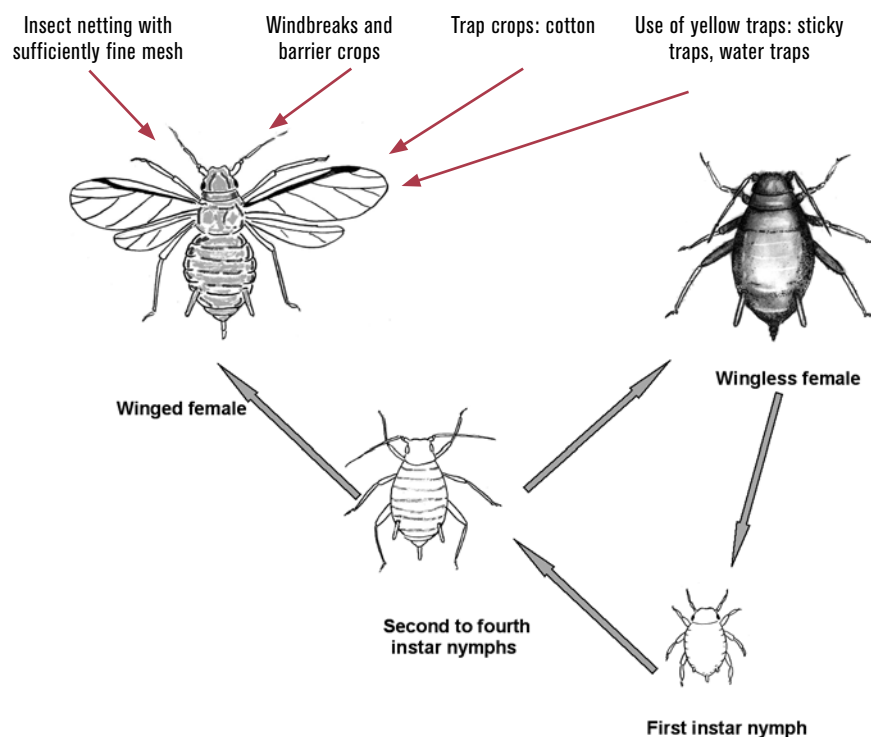
- Apply overhead irrigation, which disrupts flight of adult DBM, and washes off larvae.
- Apply pesticides for control of larvae such as pyrethroids or BT.
- Use repellent sprays such as neem based products.
- Spray contact pesticides for control of DBM adults.
- Use light traps to pull adults away from crop.
- Use pheromone traps to optimise spraying time for control.

After last harvesting

- Remove crop and source of further pupation.

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

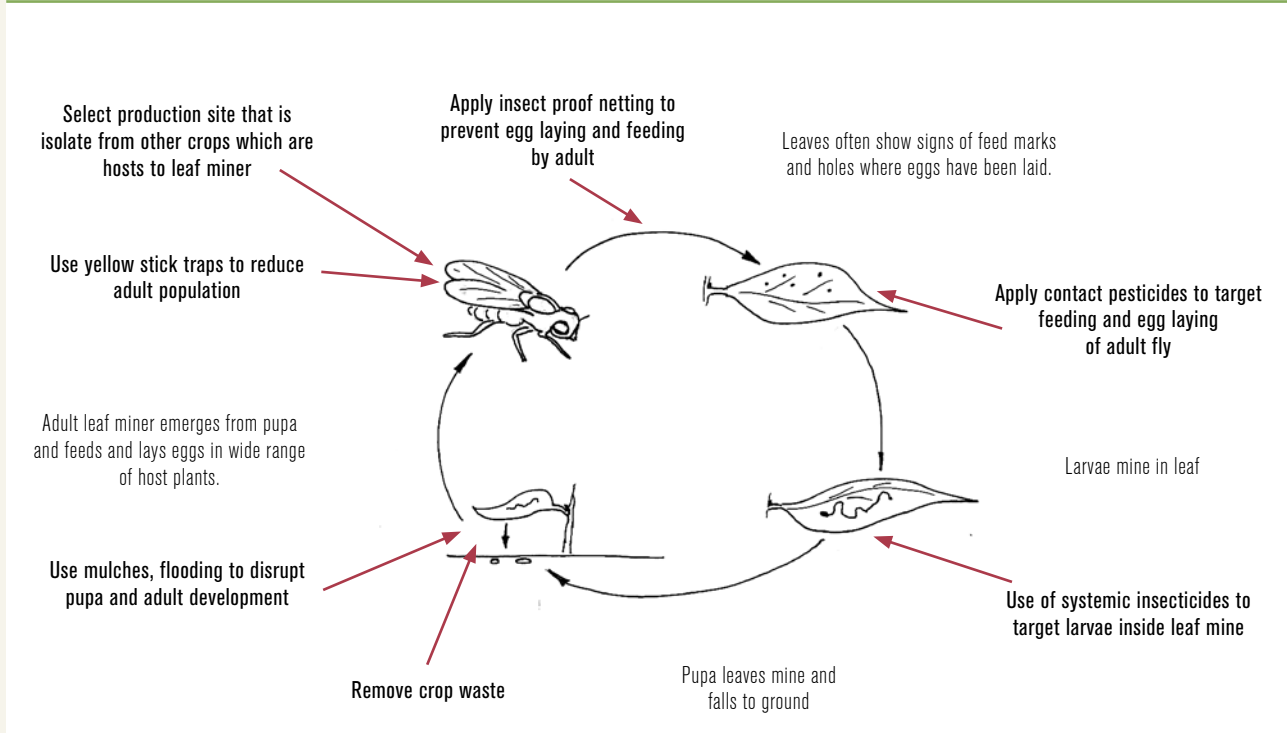
- Insect netting with sufficiently fine mesh can prevent the presence of adults on the plants.
- Sprinkler irrigation or sustained rain can reduce infestation washing-off aphids.
- Install yellow traps in the plot to monitor the population level and to reduce infestation somewhat; it is imperative to 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.

Leaf Miner

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

Nursery

- Insect netting with sufficiently fine mesh can prevent the presence of adults on the plants.
- Treatment with selective insecticides as soon as attacks have been detected on young plants.

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)

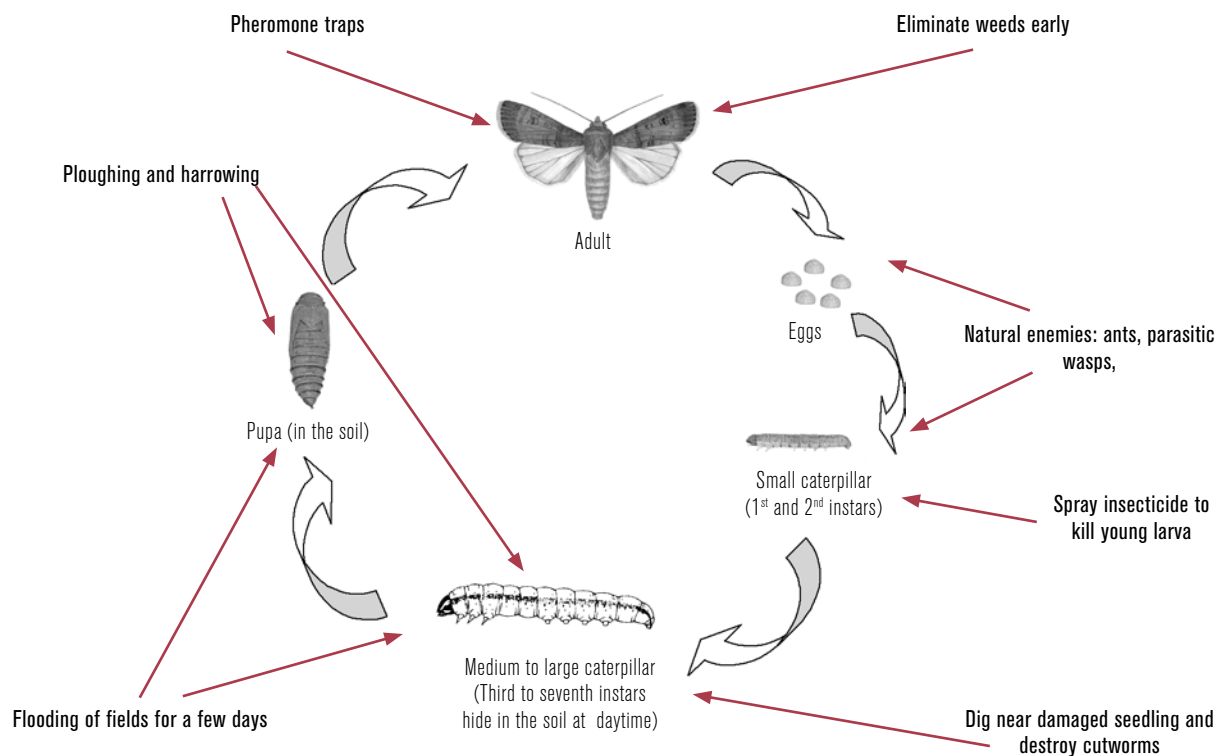
- Use systemic insecticides to control larvae stage inside the leaf mine.

After last harvesting

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

Cutworm

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

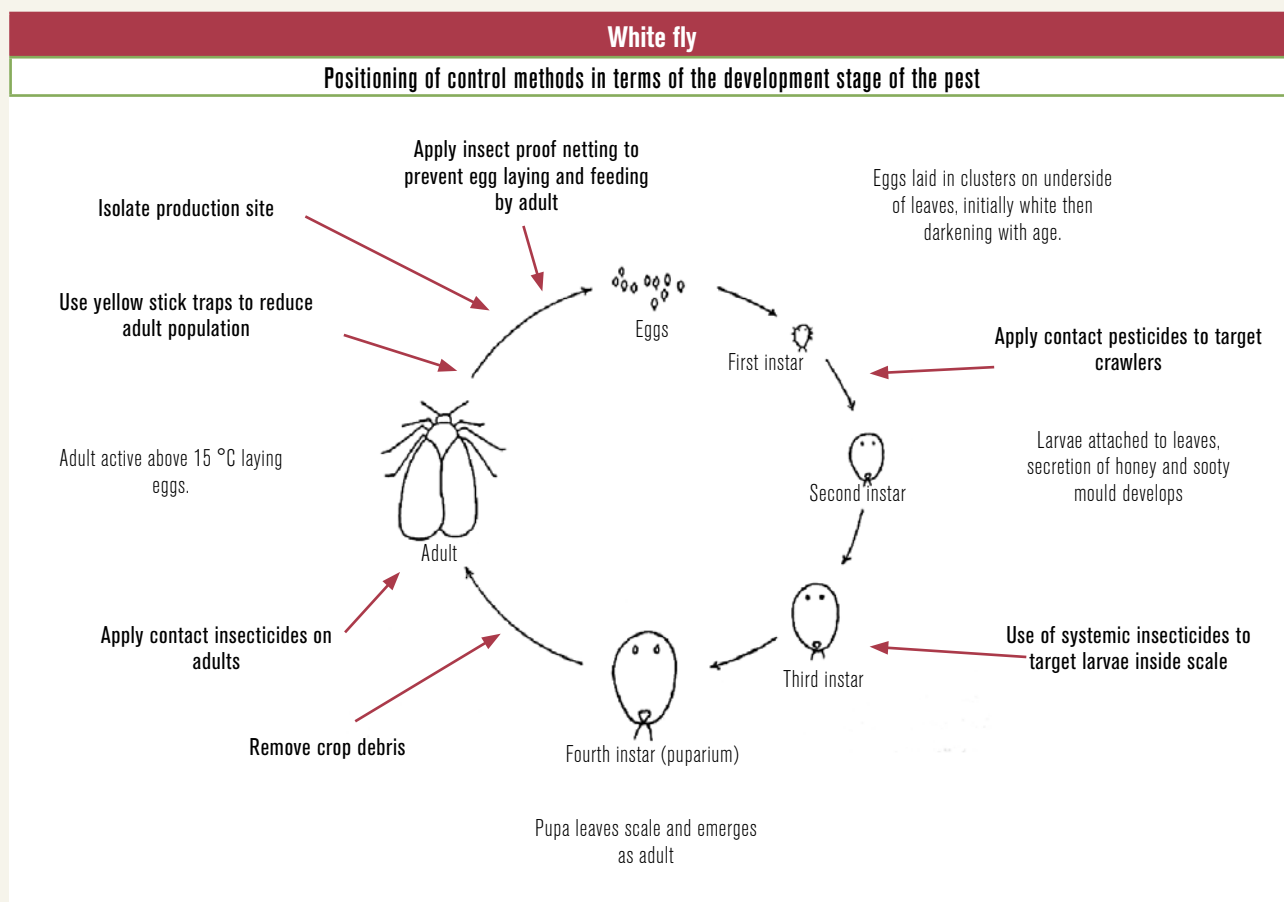
- Ploughing and harrowing to expose larva and pupae to sun and natural enemies.
- Flooding of fields for a few days before transplanting to kill larvae and pupae.
- Eliminate weeds.

During first weeks

- Spray insecticide to kill young larva.
- Dig near damaged seedling and destroy cutworms.
- Avoid treatments destructive to natural enemies.

During all plant cycle

- Weed control in the field and around the margins is important to suppress population build up on alternative host sites.



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

Nursery

- Insect netting with sufficiently fine mesh can prevent the presence of adults on the plants.
- Treatment with selective insecticides as soon as attacks have been detected on young plants.

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

- Protective netting.

During sensible stage of the plant (see 1.3.)

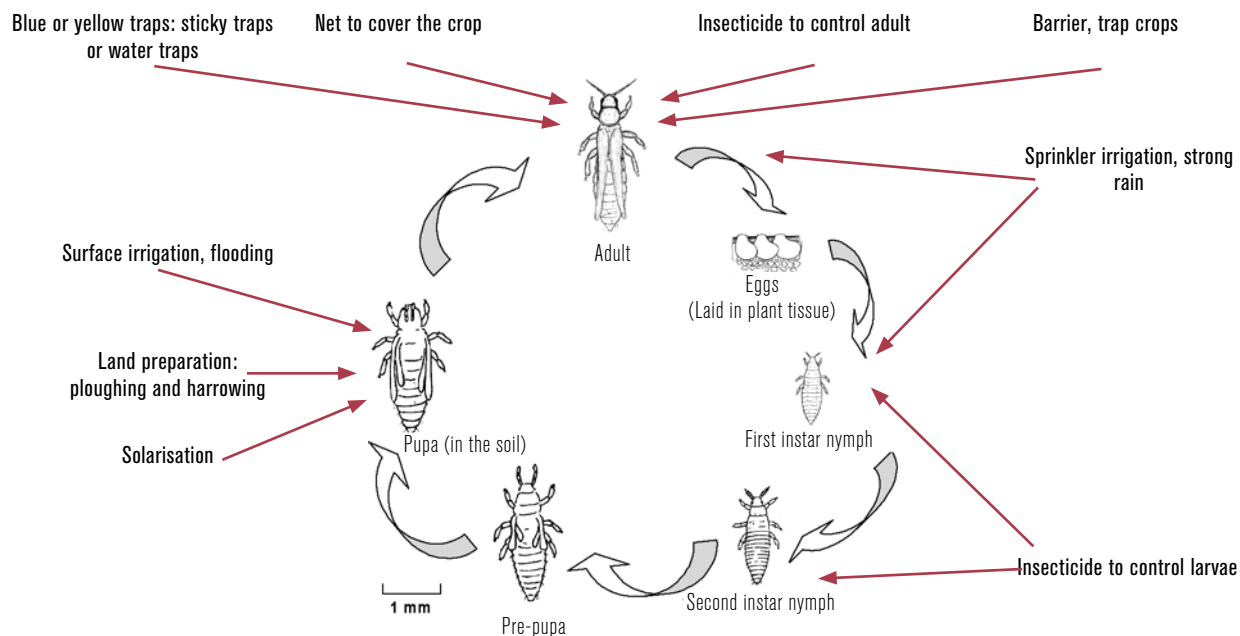
- Use systemic insecticides to control larvae stage inside the scale as they feed on the plant sap.
- Use sticky traps to reduce adult populations.
- Apply contact insecticides to target adults and crawlers, apply at cooler times of day before adult is air borne.

After last harvesting

- Remove crop source of further adult white flies.

Thrips

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



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

Nursery

- Insect netting with sufficiently fine mesh can prevent the presence of adults on the plants.
- Treatment with selective insecticides as soon as attacks have been detected on young plants.

Field

At field preparation

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

From sowing or transplanting to harvesting

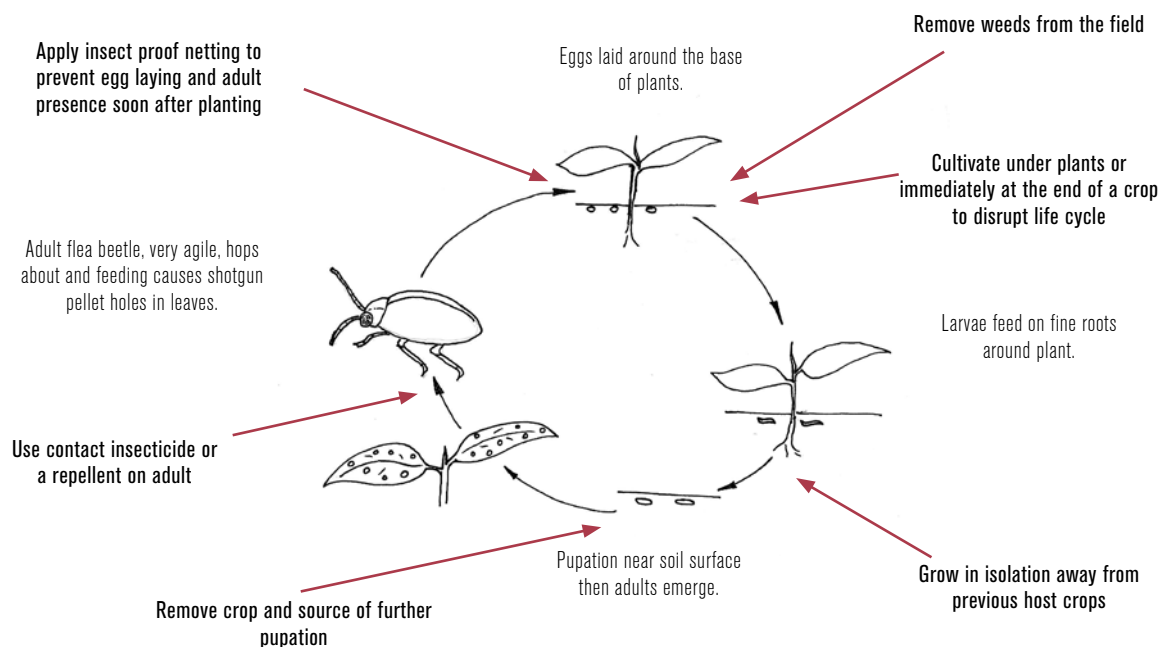
- Use sprinkler irrigation to wash-off the thrips.

During sensible stage of the plant (see 1.3.)

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

Nursery

- Insect netting can prevent the presence of adults on the plants.

Field

Before transplanting

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

After sowing or 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 or immediately at the end of a crop to disrupt the life cycle of the flea beetle by destroying eggs and larvae.
- Use repellent sprays such as neem based products.
- Spray contact pesticides for control of Flea beetle adults.
- Remove weeds that are hosts from the field.

After last harvesting

- Remove crop and source of further pupation.

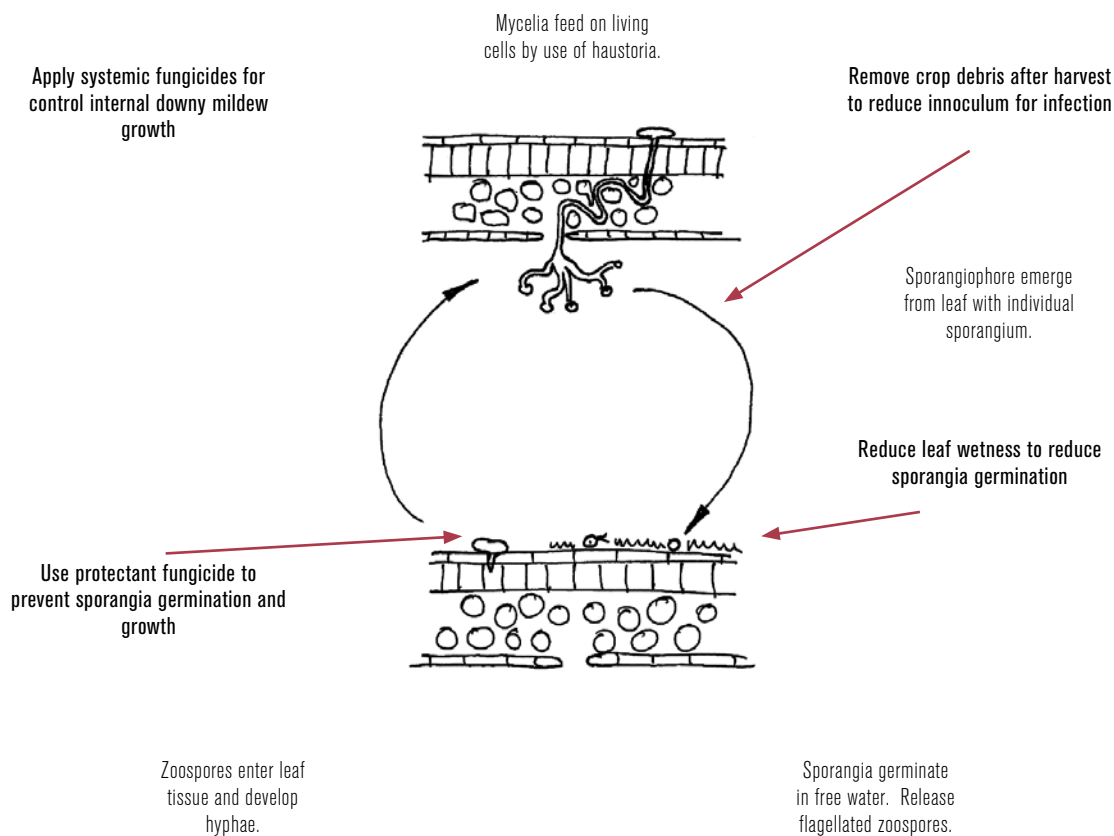
Saw fly - *Athalia lugens subsp. proxima*

Development stage of the pest	Action	Cultivation stages									
		Nursery substrate and environment preparation	Sowing	Nursery	Choice of piece of land	Field preparation	Transplanting	From transplanting to first harvest	From first harvesting to peak of harvesting	From peak of harvesting to end	After last harvesting
Layout of eggs on the plants	Avoid vicinity of host plants	X			X	X					
	Apply insect proof netting to prevent egg laying			X				X			
Development of larvae	Overhead irrigation since most of the larvae die due to drowning effect							X	X	X	
	Spray insecticides			X				X	X	X	
Pupation in the soil								X	X	X	
Emergence of adults	Ploughing to destroy the pupa					X					

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

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

At field preparation

- Avoid irrigation systems that wet leaf especially in humid conditions.
- Apply crop covers to reduce leaf wetness.

At transplanting

- Increase crop spacing in rainy season to encourage air movement.

During sensible stage of the plant (see 1.3.)

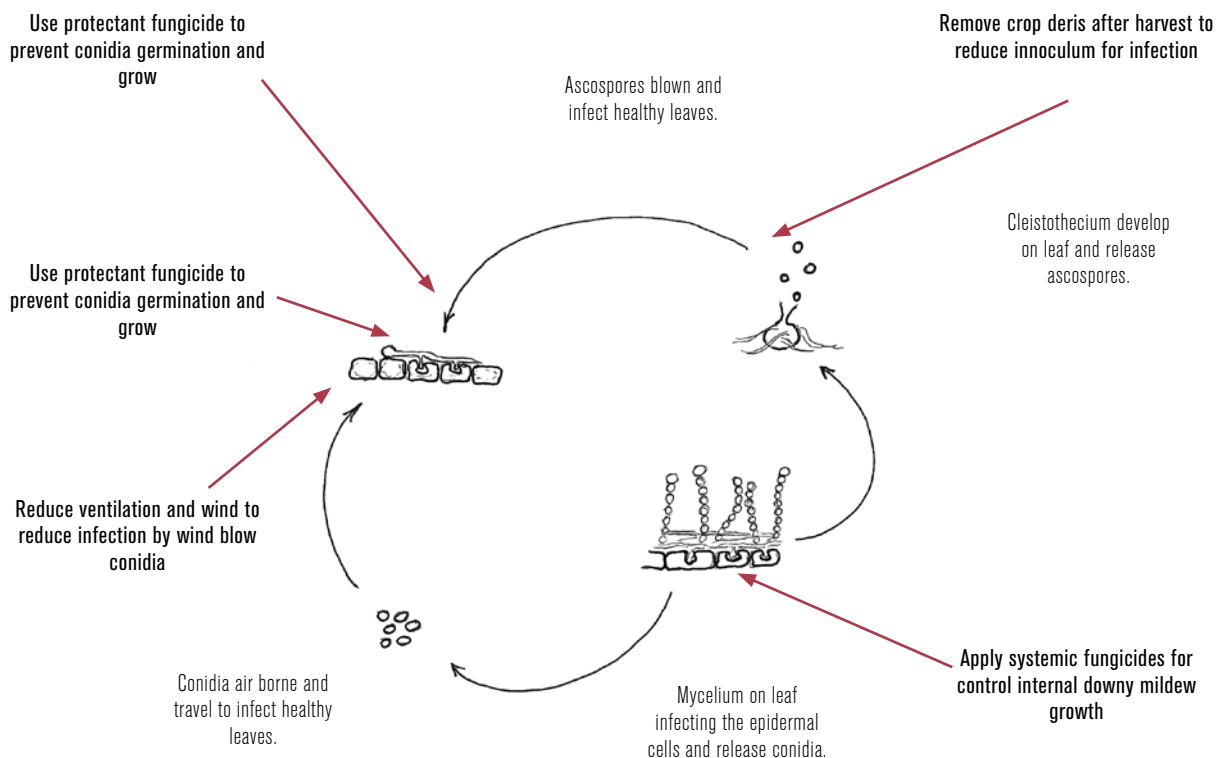
- Apply protectant fungicides where conditions are expected to encourage downy mildew such as the rainy season.
- Spray eradicant fungicides to control downy mildew.

After last harvesting

- Remove old crop as source of additional inoculum.

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

At field preparation

- Avoid irrigation systems that don't wet leaf.

During sensible stage of the plant (see 1.3.)

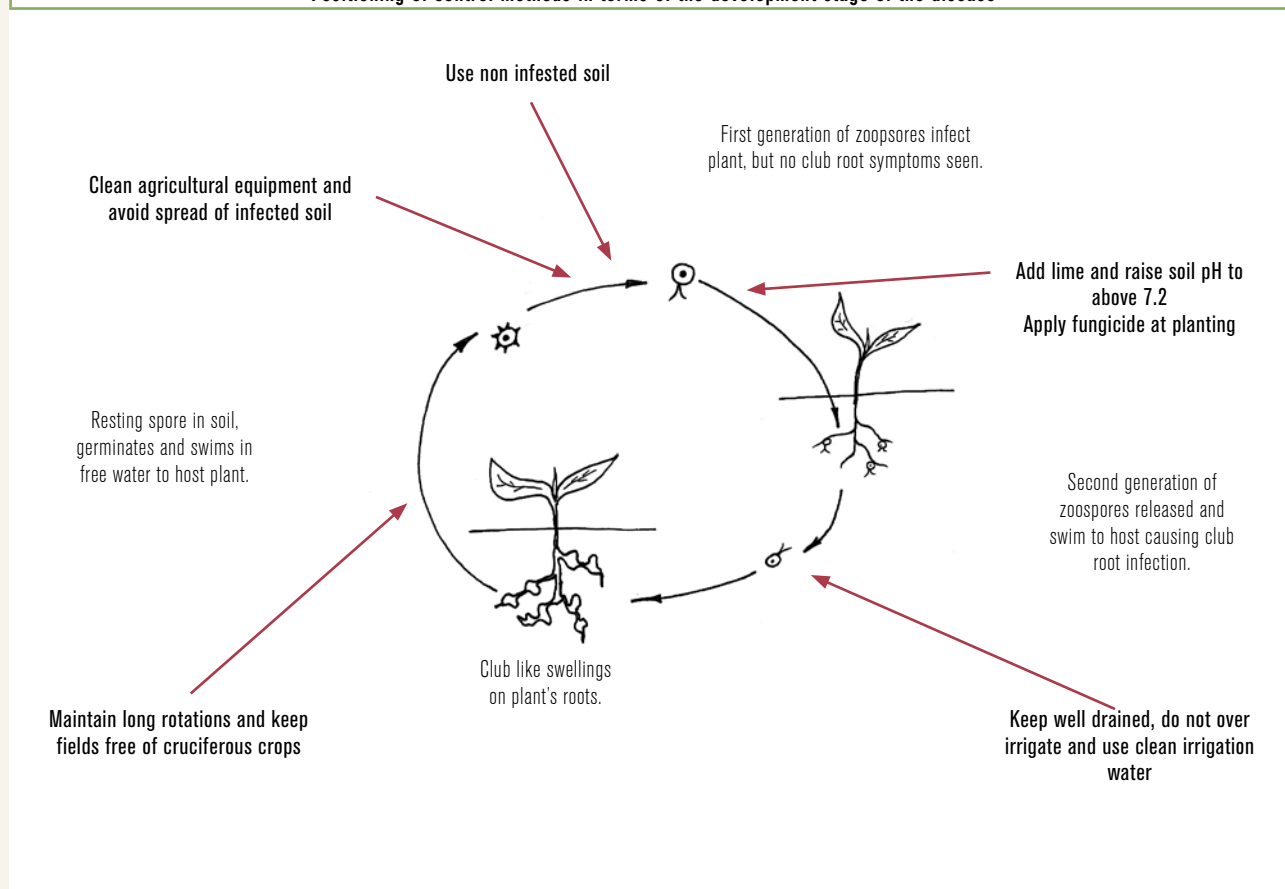
- Apply protectant fungicides where conditions are expected to encourage powdery mildew infections.
- Reduce ventilation and wind to reduce infection by wind blow conidia.
- Spray eradicant fungicides to control first signs of powdery mildew.

After last harvesting

- Remove old crop as source of additional inoculum.

Club Root

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

Nursery

- Use clean or sterilised soil.

Field

Soil choice and preparation

- Test for soil pH and add lime before planting if site has history of club root.
- Ensure field is well drained and use water from a non infected source. Drainage water from fields with club root that enters reservoirs can be used to irrigate and subsequently infect other fields.

During sensible stage of the plant (see 1.3.)

- Do not over irrigated
- Clean machinery after use and avoid movements from infected fields to clean fields.
- Apply fungicide at planting.

After last harvesting

- Maintain long rotations and keep fields free of cruciferous plants that will encourage club root.

Black leg - *Phoma lingam*

This fungal disease is often spread through hardening off processes of transplants. Topping of young plants and dipping in water before transplanting causes more susceptibility.

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 first harvest	From first harvesting to peak of harvesting	From peak of harvesting to end	After last harvesting
Germination on <i>brassica</i> plant	Seedbed conditions should not be too moist	X		X							
	Regulate irrigation programme to avoid over watering							X			
	Avoid water logging areas when planting				X	X	X				
	Use resistant varieties		X								
	Use certified seeds		X								
Development in <i>brassica</i> plant	Apply fungicides to prevent mycelium development	X		X			X	X			
Development on other crops or weeds	Eradicate cruciferous weeds from surrounding areas, and isolate from other Brassica crops reduces disease pressure		X	X		X	X	X	X	X	
	Remove and destroy infected plants			X			X				
Conservation in the soil	Use clean and/or sterile soil or potting media	X			X						
	Rotation with non- <i>brassica</i> type crops (at least 4 years)				X	X					X

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

Fusarium yellows

The fungus is persistent in the soil and has many plant hosts, so resistant varieties, good drainage, and soil-building practices such as cover crops and compost are recommended. In gardens where the disease is not present, extreme care should be taken to exclude infected seedlings.

Damping off - *Pythium* spp. and *Rhizoctonia solani*

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 first harvest	From first harvesting to peak of harvesting	From peak of harvesting to end	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								
	Apply fungicides as spraying or drenching	X		X			X				
Development in plant	Carefully examine seedlings when transplanting; discard any with signs of wirestem						X				
Development on other crops 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 or potting media	X		X	X						
	Media used for seedlings ideally should not be reused, and seedling trays should be sterilised before reuse. Ideally trays should be kept off the ground both when stored and in use	X									
	Rotation with cereals may reduce pathogen <i>Rhizoctonia</i> 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

Alternaria leaf spot - *Alternaria brassicae*

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 first harvest	From first harvesting to peak of harvesting	From peak of harvesting to end	After last harvesting
Germination on plant	If overhead irrigation used, apply early in day to allow leaves to dry quickly. Ideally use drip irrigation			X			X	X	X	X	
	Promoting air circulation in the canopy				X	X	X				
	Mulch crop to prevent splashing spores onto lower leaves						X				
	Apply fungicides on seeds or by spraying on plants to prevent germination of spores		X	X			X	X	X	X	
Development in plant	Use certified seeds		X								
	Where possible remove infected leaves							X	X	X	
	Apply fungicides to prevent development			X			X	X	X	X	
Transport by wind or water	Plant windbreaks and in-field barriers to help suppress the dispersal of spores				X	X					
Development on other crops or weeds	Remove <i>Brassica</i> weeds from within and around field					X	X	X	X	X	X
Conservation in the soil	Rotation with crops other than cole crops				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

White rust (White blister) - *Albugo candida*

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 first harvest	From first harvesting to peak of harvesting	From peak of harvesting to end	After last harvesting
Germination on plant	If overhead irrigation used, apply early in day to allow leaves to dry quickly. Ideally use drip irrigation			X			X	X	X	X	
	Apply fungicides to prevent germination of spores			X			X	X	X	X	
Development in plant	Use certified seeds		X								
	Grow tolerant cultivars		X								
	Apply fungicides to prevent development			X			X	X	X	X	
Spores production on host plants	Where possible remove infected leaves or part of flower heads							X	X	X	
Transport by wind or water	Plant windbreaks and in-field barriers to help suppress the dispersal of spores				X	X					
Development on other crops or weeds	Remove <i>Brassica</i> weeds from within and around field		X	X			X	X	X	X	X
Conservation in the soil	Carry out a good crop rotation which avoids repeated plantings of <i>Brassica</i> crops on the same piece of land				X						X
	Crop debris 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

Mycosphaerella* ring spot – *Mycosphaerella brassicicola

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 first harvest	From first harvesting to peak of harvesting	From peak of harvesting to end	After last harvesting
Germination on plant	Promoting air circulation in the canopy				X	X	X				
	Apply fungicides to prevent germination of spores			X			X	X	X	X	
Development in plant	Apply fungicides to prevent development			X			X	X	X	X	
Spores production on host plants	Where possible remove infected leaves							X	X	X	
Transport by wind or water	Plant windbreaks and in-field barriers to help suppress the dispersal of spores				X	X					
	Locate plant beds 1 mile or more from diseased fields	X		X	X						
Development on other crops or weeds	Remove <i>Brassica</i> weeds from within and around field		X	X			X	X	X	X	
Conservation in the soil	Carry out a good crop rotation which avoids repeated plantings of <i>Brassica</i> crops on the same piece of land				X						X
	Crop trash should be removed from the field and destroyed										X

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

Bacterial Black Rot – *Xanthomonas campestris* pv. *campestris*

- There are no Plant Protection Products 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 first harvest	From first harvesting to peak of harvesting	From peak of harvesting to end	After last harvesting
Infection on plant	Use certified disease-free seed and transplants		X				X				
	Do not plant cole crops where black rot has occurred in the past two to three years				X						
	Select well-drained sites with good air circulation				X						
Development in plant	Choose varieties tolerant		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	X	X	
	Regularly clean and disinfect all machinery and equipment					X	X	X	X	X	
	Not handling plants when they are wet will reduce the spread of disease-causing organisms						X	X	X	X	
	Use mulch to reduce movement of spores by rain splash					X	X				
Development on other crops or weeds	Remove <i>Brassica</i> weeds from within and around field to reduce secondary infection from alternative hosts					X	X	X	X	X	X
Conservation in the soil	Carry out a good crop rotation (at least 3 years) which avoids repeated plantings of <i>Brassica</i> crops on the same piece of land				X						X
	Use clean and/or sterile soil or potting media	X			X						
	Crop trash should be removed from the field and destroyed										X

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

Bacterial Soft Rot – *Pseudomonas* spp. and *Erwinia* spp.

- There are no PPP available, so disease prevention is very important

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 first harvest	From first harvesting to peak of harvesting	From peak of harvesting to end	After last harvesting
Infection on plant	Avoid damage by insects.							X	X	X	
Development in plant	Avoid harvesting during humid periods								X	X	
	Avoid excessive nitrogen fertilisation						X	X	X	X	
Transport by equipment or water	Regularly clean and disinfect all machinery and equipment					X	X	X	X	X	
Development on other crops or weeds	Remove <i>Brassica</i> weeds from within and around field to reduce secondary infection from alternative hosts					X	X	X	X	X	X
Conservation in the soil	Carry out a good crop rotation (at least 2 years) which avoids repeated plantings of <i>Brassica</i> crops on the same piece of land				X						X
	Plants attacked and crop trash should be removed from the field and destroyed immediately after harvest								X	X	X

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

Mosaic Viruses - Cauliflower Mosaic Virus, Turnip Mosaic Virus

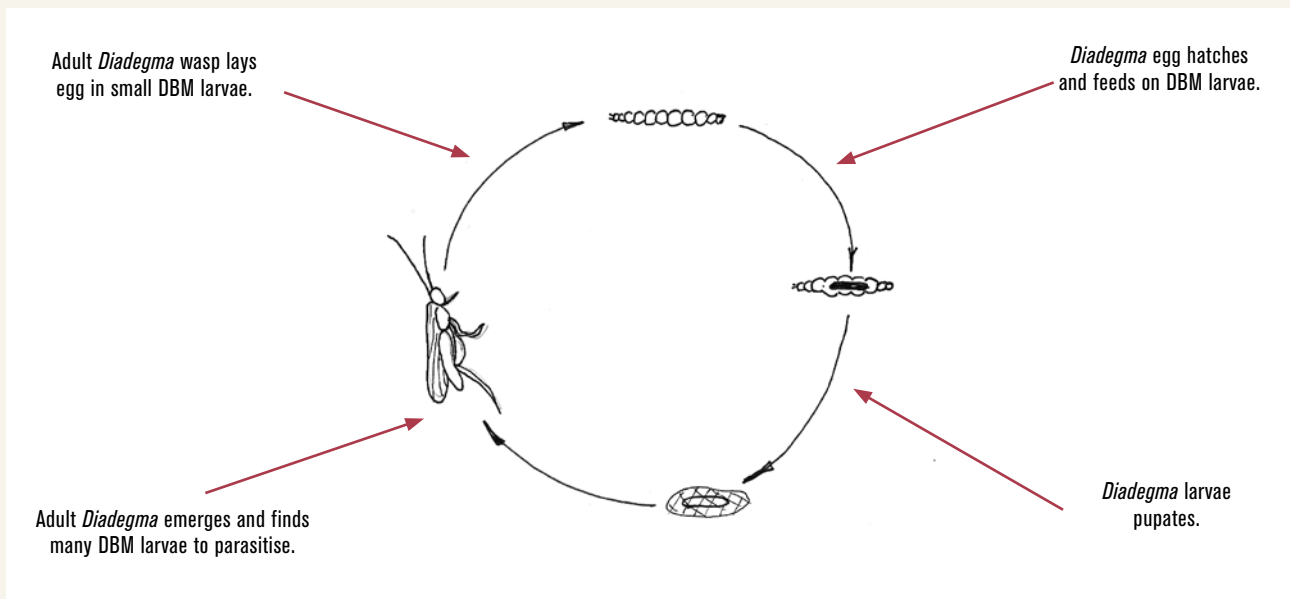
There are no chemicals available to control viruses. Aphids spread the virus, so controlling the insects that spread the virus can help to minimize the disease. This control method is difficult because infection occurs immediately after an insect feeds, and insects migrate freely between plants. A good control strategy is to maintain healthy and vigorous plants, to plant recommended varieties. Keep the area clear of crucifer weeds, such as wild mustard, that can harbour the virus.

2.3. Resistant or tolerant varieties

There are reports of *brassic*s being less susceptible to various pests and diseases, however there is no information on resistance. For instance gloss green leaf varieties of cabbage with a low wax level are reported to be less prone to cabbage aphid attack. Any information about less susceptibility of varieties should be provided by the seed or plant supplier.

2.4. Importance and use of auxiliaries

Diadegma semiclausum



Diadegma semiclausum is a parasitic wasp of Diamond Black Moth (DBM). Though not indigenous to Africa it has been used with some success in the upper altitudes of East Africa having been introduced by ICIPE. The adult *Diadegma* lays its eggs in young DBM larvae where they feed and eventually pupate and emerge as *Diadegma* adults.

Other natural enemies that could be included are :

- *Trichogramma* for DBM
- Ladybirds for aphids
- *Aphidius* for aphids
- Lacewings for aphids
- Syrphid flies for aphids



Adult of ladybird



Cocoons of *Aphidius*



Adult of *Aphidius*



Larva of syrphid

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

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 two whole plants (one on either side of the path) .

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.

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.

Stop at ten stations and examine a plant on either side of the bed

(pests numbers can be higher on sunny side of rows) = 2 plants per station.

Always scout in the stations in the same order so that comparisons can be made each week if hot spots are identified (eg the number recorded at station 1 each week can be compared to the number recorded at station 1 the next week).

Indicative thresholds proposed :

Diamond back moth	Calculate percentage plants present and treat when above 1 %
Aphids e.g. Cabbage aphid,	Calculate percentage plants present and treat when above 1 %
Saw fly	Calculate percentage plants present and treat when above 1 %
Leaf miner fly	Calculate percentage plants present and treat when above 1 %
Cut worm	Calculate percentage plants damaged and treat when above 1 %
Thrips	Calculate percentage plants present and treat when above 1 %
White fly	Calculate percentage plants present and treat when above 1 %
Flea beetle	Calculate percentage plants present and treat when above 10 %
Cabbage moth	Calculate percentage plants present and treat when above 1 %

Black leg	Protectant/Erradicant spray when first seen
Downy mildew	Protectant/Erradicant spray when first seen
Damping off	Protectant/Erradicant spray when first seen
<i>Alternaria</i> leaf spot	Protectant/Erradicant spray when first seen
Powdery mildew	Protectant/Erradicant spray when first seen
<i>Rhizoctonia</i> or wire stem	Protectant/Erradicant spray when first seen
White rust	Protectant/Erradicant spray when first seen

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

Mycosphaerella ring spots Protectant/Erradicant spray when first seen
 Club root Add lime for next crop

Mosaic Virus Consider controlling vector when above 1 % of plants affected.

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.

Farm Block Crop age (wks)
 Crop age (wks) Date scouted
 Scout name (print) Time of day Scouted

Pests										Diseases														
Station	Diamond back moth	Aphids	Saw fly	Leaf miner fly	Cut worm	Thrips	White fly	Flea beetle	Cabbage moth	Station	Black leg	Downy mildew	Yellows	Damping off	Alternaria leaf spot	Powdery mildew	Rhizoctonia or wire stem disease	White rust	<i>Mycosphaerella</i> ring spots	Club root	Black rot	Soft rot	Mosaic Virus	
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 MRLs currently in force on flowering brassica or leafy brassica is also shown, or the highest national MRL when no harmonised European MRL exists. 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.) 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.

Caterpillars (DBM, looper, sawfly larvae and other caterpillar species).

Strategy: Apply contact insecticides at the first sign of damage from larvae. Control is entirely concentrated on controlling the larvae stage of the life cycle. Ensure good leaf cover for contact 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	At sowing	From emergence to 6 weeks after emergence	From 6 weeks after emergence to first flowering	From first flowering to end of harvesting
								From emergence to harvest for leafy <i>brassica</i>		
Group 18 – Ecdysone aganists/moulting disruptors										
<u>azadirachtin</u>	All crops	15 - 60	Repeat as required	Repeat as required	2					
Group 3 – Pyrethroids (sodium channel modulators)										
<u>alpha-cypermethrin and cypermethrin</u>	Flowering <i>brassica</i>	25-40	/	/	7					
<u>deltamethrin</u>	Flowering and leafy <i>brassica</i>	17.5	3	7	7					
<u>lambda-cyhalothrin</u>	Broccoli	20	2	15	3					
	Cauliflower	20	2	15	7					
<u>pyrethrins</u>	All crops	75-100	/	/	2					
Group 5 – Spinosines										
<u>spinosad</u>	<i>Brassica</i> vegetable	96	4	7	3					
Group 11 – Microbial disruptors of insect midgut membranes										
<u><i>Bacillus thuringiensis</i> var <i>kurstaki</i></u>	All crops	/	Repeat as required	7	2					
Group 15 – Benzoylureas										
<u>diflubenzuron</u>	Flowering and leafy <i>brassica</i>	/	/	/	14					
<u>lufenuron</u>	/	/	/	/	/					
Group 2 – GABA-gated chloride channel antagonists										
<u>fipronil</u>	Flowering and leafy <i>brassica</i>	25	3	10	14					
Group 18 – Ecdysone aganists/moulting disruptors										
<u>indoxacarbe</u>	Flowering <i>brassica</i>	250	3	10	2					
Groupe 21										
<u>rotenone</u>	All crops	/	/	/	2					

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL (see part 6 of this guide).

/ elements of the recommended GAP not available

Aphids - various species

Strategy: Aphids develop in colonies therefore apply insecticides in localised hot spots. Aphids also usually occur in the growing point of the plant where the quality of sap is superior therefore pesticide application should consider this factor. Ensure good leaf cover for contact 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	At sowing	From emergence to 6 weeks after emergence	From 6 weeks after emergence to first flowering	From first flowering to end of harvesting
								From emergence to harvest for leafy <i>brassica</i>		
Group 1 - Organohosphates and carbamates										
dimethoate	Cauliflower	200	2	14	21					
pirimicarb	Flowering and leafy <i>brassica</i>	/	/	/	3					
pirimiphos methyl	/	/	/	/	/					
Group 3 - Pyrethroids and pyrethrins										
alpha-cypermethrin and cypermethrin	Flowering <i>brassica</i>	25-40	/	/	7					
bifenthrin	Flowering <i>brassica</i>	/	4	/	2					
deltamethrin	Flowering and leafy <i>brassica</i>	17.5	3	7	7					
lambda-cyhalothrin	Broccoli	20	2	15	3					
	Cauliflower	20	2	15	7					
pyrethrin	All crops	75-100	/	/	2					
Group 12										
diafenthiuron	/	/	/	/	/					
Group 9										
pymetrozine	Leafy <i>brassica</i>	/	/	/	14					
	Flowering <i>brassica</i>	/	/	/	7					
Group 4 - Nicotinic Acetylcholine receptor agonists/antagonists										
acetamiprid	All <i>brassica</i>	65	2	14	14					
imidacloprid	/	/	/	/	/					
thiamethoxam	/	/	/	/	/					
Group 21										
rotenone	/	/	/	/	2					

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL (see part 6 of this guide).

/ elements of the recommended GAP not available

Leaf miner fly – *Liriomyza* spp.

Strategy: Use contact pesticides to target feeding adults. Apply systemic or translaminar insecticides to target larvae in the leaf. Ensure good leaf cover for contact 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	At sowing	From emergence to 6 weeks after emergence	From 6 weeks after emergence to first flowering	From first flowering to end of harvesting
Group 6 – Avermectins										
abamectin	Leafy <i>brassica</i>	/	3	7	14					
Group 4c – Nereistoxin analogues										
thiocyclam hydrogen oxalate	All crops	500	3	7	14					
Group 17										
cyromazine	/	/	/	/	/					

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL (see part 6 of this guide).

/ : elements of the recommended GAP not available

Black Cutworm – *Agrotis ipsilon*

Strategy: Apply at first sign of plant damage. Spray the soil around the plants to control the larvae early in the morning when the soil is moist before the cut worm hide or bury into the soil. Young caterpillars (first and second instars) can be found on the canopy and can be easily controlled with insecticides. This is particularly effective when treatments are based on information from pheromone traps. Baits are more effective when other food is limited. In case of widespread outbreaks place baits in fields before transplanting or before plants emerge when direct sowing is done.

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	At sowing	From emergence to 6 weeks after emergence	From 6 weeks after emergence to first flowering	From first flowering to end of harvesting
Group 1 – Organohosphates and carbamates										
chlorpyrifos-ethyl	Flowering and leafy <i>brassica</i>	/	1	n.a.	42					
dichlorvos	/	/	/	/	/					
Group 3 – Pyrethroids										
alpha-cypermethrin and cypermethrin	Flowering <i>brassica</i>	25-40	/	/	7					
deltamethrin	Flowering and leafy <i>brassica</i>	17.5	3	7	7					
lambda-cyhalothrin	Broccoli	20	2	15	3					
	Cauliflower	20	2	15	7					

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL (see part 6 of this guide).

/ : elements of the recommended GAP not available

n.a. : not applicable

White fly - *Bemisia tabaci*

Strategy: Treat seed with imidacloprid or thiamethoxam to reduce pest attacking the seedling in the first four weeks of the crop. Use insecticide at the first sign of the pest. Apply contact insecticides early morning or late evening when pest are static and remain on the leaf.

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	At sowing	From emergence to 6 weeks after emergence	From 6 weeks after emergence to first flowering	From first flowering to end of harvesting
								From emergence to harvest for leafy <i>brassica</i>		
Group 3 – Pyrethroids and pyrethrins										
alpha-cypermethrin and cypermethrin	Flowering <i>brassica</i>	40	/	/	7					
bifenthrin	Flowering <i>brassica</i>	/	4	/	2					
deltamethrin	Flowering and leafy <i>brassica</i>	17.5	3	7	7					
lambda-cyhalothrin	Broccoli	20	2	15	3					
	Cauliflower	20	2	15	7					
pyrethrins	All crops	75-100	/	/	2					
Group 4 – Nicotinic Acetylcholine receptor agonists/antagonists										
imidacloprid	/	/	/	/	/					
thiamethoxam	/	/	/	/	/					
Group 16										
buprofezin	/	/	/	/	/					
Group 12										
diafenthiuron	/	/	/	/	/					

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL (see part 6 of this guide).

/ elements of the recommended GAP not available

Thrips – *Frankliniella* spp.

Strategy: Apply contact insecticides early in the morning or late afternoon when thrips are active and visible. During the day thrips hide and make spraying ineffective. With spray use lure such as molasses or sugar solutions to attract thrips out of their hiding places. Ensure good leaf cover for contact 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	At sowing	From emergence to 6 weeks after emergence	From 6 weeks after emergence to first flowering	From first flowering to end of harvesting
Group 3 – Pyrethroids										
bifenthrin	Flowering <i>brassica</i>	/	4	/	2					
deltamethrin	Flowering and leafy <i>brassica</i>	17.5	3	7	7					
lambda-cyhalothrin	Broccoli	20	2	15	3					
	Cauliflower	20	2	15	7					
Group 5 – Spinosines										
spinosad	<i>Brassica</i> vegetable	96	4	10	3					
Group 4c – Nereistoxin analogues										
thiocyclam hydrogen oxalate	All crops	500	3	7	14					
Group 12										
diafenthiuron	/	/	/	/	/					
Group 4 – Nicotinic Acetylcholine receptor agonists/antagonists										
imidacloprid	/	/	/	/	/					
thiamethoxam	/	/	/	/	/					
Group 21										
rotenone	/	/	/	/	2					

Flea beetle – *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	At sowing	From emergence to 6 weeks after emergence	From 6 weeks after emergence to first flowering	From first flowering to end of harvesting
Group 3 – Pyrethroids and pyrethrins										
deltamethrin	Flowering and leafy <i>brassica</i>	17.5	3	7	7					
pyrethrin	All crops	75-100	/	/	2					

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL (see part 6 of this guide).

/ elements of the recommended GAP not available

Downy Mildew - *Peronospora parasitica*

Strategy: It is essential to control from the nursery applying preventively a fungicide. In the field apply fungicides at the first sign of infection. Repeat as necessary by rotating fungicide groups.

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	At sowing	From emergence to 6 weeks after emergence	From 6 weeks after emergence to first flowering	From first flowering to end of harvesting
Group 33 - Phosphonates										
fosetyl aluminium	/	2400	2	14	14					
Not classified										
dimethyl didecyl ammonium chloride	/	/	/	/	/					
Group 11 - Qol fungicides										
azoxystrobin	Flowering and leafy <i>brassica</i>	250	2	8	14					
Group M - Multisite activity										
chlorothalonil	Flowering <i>brassica</i>	1500	2	14	10					
mancozeb	Flowering <i>brassica</i>	1600	4	14	30					
	Leafy <i>brassica</i>	1600	4	7	30					
Group 4 - PhenylAmide fungicides										
metalaxyl-M	Flowering <i>brassica</i>	100	3	10	21					
Group 28 - Carbamates										
propamocarb hydrochloride	Flowering <i>brassica</i>	/	2	14	/					

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL (see part 6 of this guide).

/ elements of the recommended GAP not available

Damping off – *Rhizoctonia solani* and *Pythium* spp.

Strategy: Undertake soil treatment well in advance of crop. Prepare firm fine seed bed and raise to nearly soil capacity. Remove large organic matter. After application apply irrigation to seal soil surface no longer than 2 hours after soil treatment applied. Conduct a seed germination test to ensure safe to plant two or three weeks after soil treatment. Seed treatment may help combat these diseases treating weak or damaged seed may reduce germination and/or seed and seedling vigor.

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	At sowing	From emergence to 6 weeks after emergence	From 6 weeks after emergence to first flowering	From first flowering to end of harvesting
Group M – Dithiocarbamates and relatives										
<u>thiram</u>	All crops	/	1	n.a.	n.a.	seed treatment				
Not classified										
<u>dazomet</u>	All crops	/	1	n.a.	n.a.	soil treatment				
<u>metham sodium</u>	All crops	/	1	n.a.	n.a.	soil treatment				
Group 28 – Carbamates										
<u>propamocarb hydrochloride</u>	/	/	/	/	/					
Group 4 – PhenylAmide fungicides										
<u>metalaxyl-M</u>	Flowering <i>brassica</i>	1000	2	25	14	soil treatment				
		/	1	n.a.	n.a.	seed treatment				
Group 7 – Carboximides										
boscalid	Flowering and leafy <i>brassica</i>	80 g a.s./100 kg seeds	1	n.a.	n.a.	seed treatment				

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL (see part 6 of this guide).

/ : elements of the recommended GAP not available

n.a. : not applicable

Powdery Mildew - *Erysiphe polygoni*

Strategy: Apply protectant fungicides when weather is hot and dry and crop has a history of disease. At the first sign of disease apply curative fungicides.

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	At sowing	From emergence to 6 weeks after emergence	From 6 weeks after emergence to first flowering	From first flowering to end of harvesting
								From emergence to harvest for leafy <i>brassica</i>		
Group M - Multisite activity										
chlorothalonil	Flowering <i>brassica</i>	1500	2	14	10					
sulphur	/	/	/	/	/					
Group 8 - Hydroxy-(2-amino) pyrimidines										
bupirimate	/	/	/	/	/					
Group 3 - DMI fungicides										
bitertanol	/	/	/	/	/					
myclobutanil	/	/	/	/	/					
tebuconazole	Cauliflower	125	3	14	21					
triadimefon	/	/	/	/	/					
Group 11 - Qol fungicides										
trifloxystrobin	Vegetable <i>brassica</i>	/	/	21	21					
Group 7 - Carboximides										
boscalid	Flowering and leafy <i>brassica</i>	80 g a.s./100 kg seeds	1	/		seed treatment				

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL (see part 6 of this guide).

/ elements of the recommended GAP not available

White Rust - *Albugo candida*

Strategy: Use preventative sprays when weather wet or humid, alternate with different fungicidal groups, spray when first sign of disease.

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	At sowing	From emergence to 6 weeks after emergence	From 6 weeks after emergence to first flowering	From first flowering to end of harvesting
								From emergence to harvest for leafy <i>brassica</i>		
Group 3 - DMI fungicides										
tebuconazole	Cauliflower	125	3	14	21					
Group 11 - fungicides Qol										
azoxystrobin	Flowering and leafy <i>brassica</i>	250	2	8	14					
pyraclostrobin	Flowering and leafy <i>brassica</i>	67-200	3	14	14					
trifloxystrobin	Vegetable <i>brassica</i>	/	/	21	21					
Group 7 - carboximides										
boscalid	Flowering and leafy <i>brassica</i>	267	3	7-14	14					
Group 4 - PhenylAmide fungicides										
metalaxyl-M	Flowering <i>brassica</i>	100	3	10	21					

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL (see part 6 of this guide).

/ elements of the recommended GAP not available

Alternaria – Alternaria brassicae

Strategy: Select one of the following fungicides, if disease is severe enough to warrant chemical control. Spray every 7 to 10 days after transplants are set.

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	At sowing	From emergence to 6 weeks after emergence	From 6 weeks after emergence to first flowering	From first flowering to end of harvesting
Group M – Multisite activity										
chlorothalonil	Flowering <i>brassica</i>	1500	2	14	10					
mancozeb	Flowering <i>brassica</i>	1600	4	14	30					
	Leafy <i>brassica</i>	1600	4	7	30					
Group 3 – DMI - fungicides										
difenoconazole	Leafy and flowering <i>brassica</i>	125	3	14	14					
tebuconazole	Cauliflower	125	3	14	21					
Group 2 – dicarboximides										
iprodione	Vegetable <i>brassica</i>	500	2	/	14					
Group 11 – Qol fungicides										
azoxystrobin	Flowering and leafy <i>brassica</i>	250	2	8	14					
trifloxystrobin	Vegetable <i>brassica</i>	/	/	21	21					
Group 7 – Carboximides										
boscalid	Flowering and leafy <i>brassica</i>	267	3	7-14	14					

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL (see part 6 of this guide).

/ elements of the recommended GAP not available

Mycosphaerella ring spot – Mycosphaerella brassicicola

Strategy: Begin application prior to 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	At sowing	From emergence to 6 weeks after emergence	From 6 weeks after emergence to first flowering	From first flowering to end of harvesting
Group M – Multisite activity										
chlorothalonil	Flowering <i>brassica</i>	1500	2	14	10					
Group 3 – DMI - fungicides										
difenoconazole	Leafy and flowering <i>brassica</i>	125	3	14	14					
tebuconazole	Cauliflower	125	3	14	21					
Group 1 – MBC fungicides										
thiophanate-methyl	/	/	/	/	/					
Group 11 – Qol fungicides										
trifloxystrobin	Vegetable <i>brassica</i>	/	/	21	21					
Group 7 – Carboximides										
boscalid	Flowering and leafy <i>brassica</i>	267	3	7-14	14					

* The elements of the recommended GAP shown here allow to comply with the harmonised European MRL (see part 6 of this guide).

/ 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. GAP indicated is the GAP of the local registration and not the GAP to comply to MRLs in force in Europe.

Registration of insecticides permitted on *brassicaceae* in Kenya

active substance	crops	targets						
		Caterpillars	Aphids	Cutworms	Leaf Miner	Thrips	White fly	Broad spectrum
abamectin	vegetables				X			
alpha cypermethrin	vegetables			X				X
azadirachtin	vegetables							X
<i>Bacillus thuringiensis</i> (var <i>kurstaki</i>)	vegetables	X						
buprofezin	vegetables						X	
chlorpyrifos	vegetables						X	
cyromazine	vegetables				X			
deltamethrin	vegetables					X		X
diazinon	vegetables					X		X
dichlorvos	vegetables		X				X	X
diafenthiuron	vegetables		X					X
diflubenzuron	vegetables	X						
dimethoate	vegetables						X	X
fipronil	vegetables	X						X
imidacloprid	vegetables						X	
lambda - cyhalothrin	vegetables	X						X
lufenuron	vegetables	X						
methoxyfenozide	vegetables	X						
pirimicarb	vegetables		X					
pirimiphos methyl	vegetables		X					X
pymetrozine	vegetables						X	X
spinosad	vegetables	X				X		
thiocyclam hydrogen oxalate	horticultural crops				X			

/ not available

Registration of fungicides permitted on *Brassicaceae* in Kenya

active substance	crops	targets				
		Powdery Mildew	Downy Mildew	Damping off	White Rusts	Broad spectrum
azoxystrobin	vegetables		X			X
bitertanol	vegetables	X				X
bupirimate	vegetables	X				
chlorothalonil	vegetables	X				X
dazomet	vegetables			X		X
dimethyl didecyl ammonium chloride	Vegetable		X			X
metalaxyl + mancozeb	vegetables		X			X
metham sodium	vegetables			X		X
myclobutanil	vegetables	X				
propamocarb hydrochloride	vegetables			X		X
tebuconazole	vegetables				X	X
thiram	general crops			X		X
triadimefon	vegetables	X				

/ not available

6. European regulations and pesticide residues

Status of the active substances in Directive 91/414; European harmonised MRLs in May 2009.

Caution: The information contained in this table is subject to change by future directives of the Commission of the European Communities.

MRL for flowering <i>brassica</i> * in Europe		
Active substance	European regulations	
	Status DIR 91/414	European MRL
Abamectin	Annex 1	0.01
Acetamiprid	Annex 1	0.01
Alpha-cypermethrin	Annex 1	0.5
Azadirachtin	Not included**	1
Azoxystrobin	Annex 1	0.5
<i>Bacillus thuringiensis</i> (var. <i>kurstaki</i>)	Annex 1	/
Bifenthrin	Notified list 3a	0.2
Bitertanol	Not included**	0.05
Boscalid	Annex 1	1
Bupirimate	Not included**	0.05
Buprofezin	Withdrawn	0.05
Chlorothalonil	Annex 1	3
Chlorpyrifos-ethyl	Annex 1	0.05
Cypermethrin	Annex 1	0.5
Cyromazine	Annex 1	0.05
Dazomet	Not included**	0.02
Deltamethrin	Annex 1	0.1
Diafenthiuron	Withdrawn	0.01
Dichlorvos	Withdrawn	0.01
Difenoconazole	Annex 1	0.2
Diflubenzuron	Annex 1	1
Dimethoate	Annex 1	0.02 ¹ 0.2 ²
Didecyl dimethyl ammonium chlorid	Notified list 4f	/
Fipronil	Annex 1	0.02
Fosetyl-Al	Annex 1	10
Imidacloprid	Annex 1	0.5
Indoxacarbe	Annex 1	0.3
Iprodione	Annex 1	0.1
Lambda-cyhalothrin	Annex 1	0.1
Lufenuron	Annex 1	0.2

* MRLs indicated in this table are valid for all the group of "Flowering *brassica*" which include cauliflower and broccoli. If a specific MRL to broccoli¹ or cauliflower² exists this is clearly indicated.

** 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 flowering *brassica* * in Europe (continued)

Active substance	European regulations	
	Status DIR 91/414	European MRL
Mancozeb	Annex 1	1
Mefenoxam (Metalaxyl-M)	Annex 1	0.2
Metam sodium	Notified list 3b	0.02
Myclobutanil	Not included**	0.02
Pirimicarb	Annex 1	2
Propamocarb hydrochlorid	Annex 1	10
Pymetrozine	Annex 1	0.02
Pyraclostrobin	Annex 1	0.1
Pyrethrin	Annex 1	1
Pirimiphos-methyl	Annex 1	1
Rotenone	Withdrawn	0.01
Spinosad	Annex 1	2
Sulphur	Annex 1	50
Thiamethoxam	Annex 1	0.2
Thiram	Annex 1	0.1
Thiocyclam hydrogen oxalate	Withdrawn	0.01
Triadimefon	Withdrawn	0.1
Tebuconazole	Annex 1	1
Thiophanate-methyl	Annex 1	0.1
Trifloxystrobin	Annex 1	0.05

* MRLs indicated in this table are valid for all the group of "Flowering *brassica*" which include cauliflower and broccoli. If a specific MRL to broccoli¹ or cauliflower² exists this is clearly indicated.

** 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 leafy *brassica* * in Europe

Active substance	European regulations	
	Status DIR 91/414	European MRL
Abamectin	Annex 1	0.01
Acetamiprid	Annex 1	0.01
Alpha-cypermethrin	Annex 1	1
Azadirachtin	Not included**	1
Azoxystrobin	Annex 1	5
<i>Bacillus thuringiensis</i>	Annex 1	/
Bifenthrin	Notified list 3a	0.05
Bitertanol	Not included**	0.05
Boscalid	Annex 1	10
Bupirimate	Not included**	0.05
Buprofezin	Withdrawn	0.05
Chlorothalonil	Annex 1	0.01
Chlorpyrifos-ethyl	Annex 1	0.5 ¹ 0.05 ²
Didecyl dimethyl ammonium chlorid	Notified List 4f	
Cypermethrin	Annex 1	1
Cyromazine	Annex 1	0.05
Dazomet	Not included**	0.02

* MRLs indicated in this table are valid for all the group of "Leafy *brassica*" which include various Chinese cabbages and kale. If a specific MRL to Chinese cabbage¹ or kale² exists this is clearly indicated.

** 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 leafy <i>brassica</i> * in Europe (continued)		
Active substance	European regulations	
	Status DIR 91/414	European MRL
Deltamethrin	Annex 1	0.5
Diafenthuron	Withdrawn	0.01
Dichlorvos	Withdrawn	0.01
Difenoconazole	Annex 1	2
Diflubenzuron	Annex 1	1
Dimethoate	Annex 1	0.02
Didecyl dimethyl ammonium chlorid	Notified list 4f	0.01
Fipronil	Annex 1	0.05
Fosetyl-Al	Annex 1	10
Imidacloprid	Annex 1	0.5 ¹ 0.3 ²
Indoxacarbe	Annex 1	0.2
Iprodione	Annex 1	5 ¹ 0.02 ²
Lambda-cyhalothrin	Annex 1	1
Lufenuron	Annex 1	0.2
Mancozeb	Annex 1	0.5
Mefenoxam (Metalaxyl-M)	Annex 1	0.05 ¹ 0.2 ²
Metam sodium	Notified list 3b	0.02
Myclobutanil	Not included**	0.02
Primicarb	Annex 1	2 ¹ 1 ²
Propamocarb hydrochlorid	Annex 1	10
Pymetrozine	Annex 1	0.2
Pyraclostrobin	Annex 1	0.02
Pyrethrin	Annex 1	1
Pyrimiphos-methyl	Annex 1	0.05
Rotenone	Withdrawn	0.01
Spinosad	Annex 1	2
Sulphur	Annex 1	50
Thiamethoxam	Annex 1	0.2
Thiram	Annex 1	0.1
Thiocyclam hydrogen oxalate	Withdrawn	0.01
Triadimefon	Withdrawn	0.1
Tebuconazole	Annex 1	1 ¹ 0.05 ²
Thiophanate-methyl	Annex 1	0.1
Trifloxystrobin	Annex 1	0.02

* MRLs indicated in this table are valid for all the group of "Leafy *brassica*" which include various Chinese cabbages and kale. If a specific MRL to Chinese cabbage¹ or kale² exists this is clearly indicated.

** 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 for 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 and useful documents

Dixon, G. R. (2007). Vegetable Brassicas and related crucifers. CAB International, Wallingford, UK.

Dobson, H, Cooper, J., Manyangarirwa, W., Karuma, J., Chiimba, W. (2002). Integrated Vegetable Pest Management – safe and sustainable protection of small-scale brassicas and tomatoes. Natural Resources Institute, Chatham, UK.

Anon. (2001). Crop Protection Compendium. CAB international, Wallingford, UK

Malais, M.H. and Ravensberg, W. J. (2003). Knowing and Recognising. Koppert biological control systems. Reed Business information, The Netherlands.

Anon (1992). Integrated Pest Management for cole crops and lettuce. University of California Publication 3307. California, USA

Koike, S. T., Gladders, P., and Paulus, A. O., (2007). Vegetable Diseases – A colour Handbook. Academic press, Boston, USA.

2. Useful websites

Main pests and diseases of brassicas and tomatoes.

www.cpp.uk.com/UPLOADS/publications/downloads/PestsAndDiseasesEnglish.pdf

Sources of information about brassica crops.

http://www.sardi.sa.gov.au/pdfserve/ento/dbm/publications/project_handbook/section8_irm_text.pdf

Cabbage, Broccoli, and Other Cole Crops

<http://www.ncsu.edu/sustainable/profiles/c09cole.html>

Crop Management Practices - Brassicas

[CROPhttp://www.nysaes.cornell.edu/pp/resourceguide/cmp/brassicas.php](http://www.nysaes.cornell.edu/pp/resourceguide/cmp/brassicas.php)

Maladies fongiques des crucifères cultivées

<http://www.omafra.gov.on.ca/french/crops/facts/90-255.htm#anchor724647>

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 mays*)
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 annum*, *Capsicum chinense*) and sweet peppers (*Capsicum annum*)
Citrus (*Citrus* sp.)
Coconut (*Cocos 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.)

