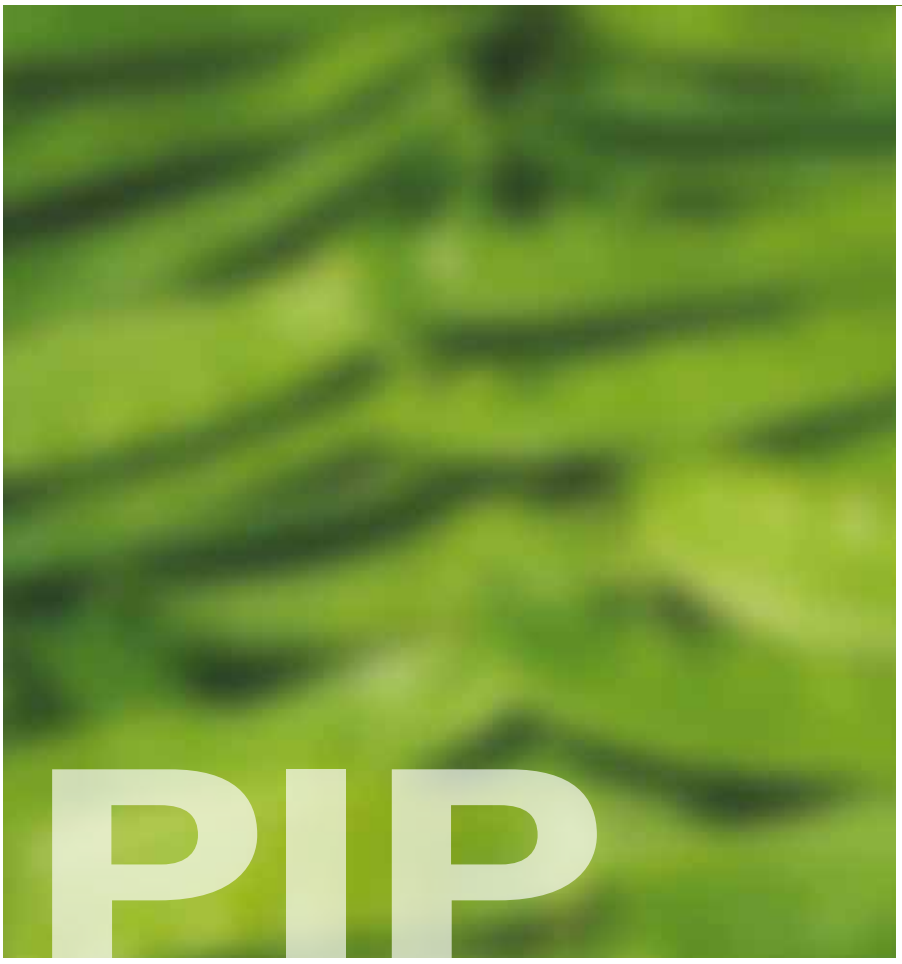

GUIDE TO GOOD CROP PROTECTION PRACTICES

FOR BABY AND SWEET CORN (*ZEA MAYIS*)

COLEACP is an international network promoting sustainable horticultural trade.

PIP is a European cooperation programme managed by COLEACP. It is financed by the European Development Fund and implemented at the request of the ACP (Africa, Caribbean and Pacific) Group of States.

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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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 Regulation 1107/2009, which must comply with standards for pesticide residues. Some of these active substances have been tested through a field trials programme and the residue level of each active substance has been measured. 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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FOR SUSTAINABLE DEVELOPMENT OF THE ACP HORTICULTURAL INDUSTRY

Table of contents

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 fruits per plant, smaller-sized cobs, lower quality of cobs.

INSECTS					
Extent	Organs attacked	Types of loss			
	Seeds and seedlings	Number of plants	Number of cobs/plant	Size of cobs	Quality of cobs at maturity
Seed corn maggot - *Hylemya platura*					
+	The maggot bore into the seeds and seedlings	Seed or seedling death			
Seed corn beetle - *Agonoderus lecontei*					
+	Adult attack germinating seeds and seedlings	Seed or seedling death	Reduced by stunted growth		
Wireworms - *Coleoptera*, family *Elaterideae*					
+	Feeding at the base of young plants	Killing of young plants	Reduced by stunted growth		
Black cutworm - *Agrotis ipsilon*					
++	Feeding at the base of young plants	Reduced by cut off young plants soon after emergence			

INSECTS (*cont.*)						
Extent	Organs attacked		Types of loss			
	Roots	Stems and/or foliage	Number of plants	Number of cobs/plant	Size of cobs	Quality of cobs at maturity
Maize stalk borer - *Busseola fusca*						
+++		Holes in young unfurled upper leaves from young larvae; older larvae bore into stalk	Can cause death of the plant if stalk affected	Broken plants and dropped ears Reduced ear and kernel size		
Corn root aphid - *Anuraphis maidiradicis*						
++	The aphids pierces roots			Reduced by retarded growth Heavily infested seedlings rarely grow taller than 25 cm		
Maize aphid - *Rhopalosiphum maidis*						
+		Attacks are on leaves		A black fungal growth (called sooty mold) often occurs on the honeydew secreted by aphids. This can lead to reduced growing		

VIRUSES					
Extent	Organs attacked	Types of loss			
	Entire plant	Number of plants	Number of cobs/plant	Size of cobs	Quality of cobs at maturity
Maize Streak Virus (MSV) Transmitted by leafhoppers - *Cicadulina* spp.					
+++	Spread in the whole plant after transmission via insects		Reduced by retarded crop growth		

FUNGI						
Extent	Organs attacked		Types of loss			
	Leaves	Fruit	Number of plants	Number of cobs/ plant	Size of cobs	Quality of cobs at maturity
Common Rust - *Puccinia sorghi*						
++	Development of pustules on the upper and lower leaf surfaces			Reduced by loss of photosynthetic area		
Northern Leaf Blight - *Setosphaeria turcica* (syn. *Helminthosporium turcicum*) (anamorph *Exserohilum turcicum*)						
++	Develop on the upper leaf surfaces			Reduced growth by loss of photosynthetic area		Infection during early stage of growth may cause heavy loss in ear fill
Grey leaf spot - *Cercospora zeae-maydis*						
++	The lower leaves of the corn plant are most often the sites of initial infections. The upper leaves are infected afterwards		Severe infestation can lead to premature plant death	Reduced if predisposes plant to stalk rot by other fungi		
Ear and stem rots Various spp. of fungi e.g. *Fusarium, Aspergillus*						
+	Infect stalks following stalk borer attack			Damage results in the failure of the ear to develop		Some infected kernels in the ears

1.2. Identification and damage

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

INSECTS

Seed corn maggot - *Hylemya platura*

Seed corn maggot damage is easily visible as the maggots will be present and boring into the seeds. It occurs in both sprouting seeds in the soil and seedlings. They feed on the seed contents causing seed death or poor germination.

Larva

Seed corn beetle - *Agonoderus lecontei*

The damaging stage of the seed corn beetle is the adult. They attack germinating seed and destroy the germ. Holes or hollowed out seeds with dead or stunted sprouts can be seen.

Adult

Wireworms - species of the order *Coleoptera*, family *Elateridae*

Wireworm injury is often associated with a small feeding hole at the base of the young plant, which may kill the growing point and stunt plant growth.

Larva

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.

Caterpillar and cut corn

Maize Stalk Borer - *Busseola fusca* (or African Stalk Borer)

Damage is caused by the larvae. Young larvae (termed top grubs) eat the young unfurled upper leaves, riddling them with holes that become apparent once the leaves unfurl. The older larvae bore into the stalk and can cause the death of the plant. There is only one older larva per stalk as they are cannibalistic. The female lays eggs between the leaf sheaths and stalk. A batch of up to 150 eggs between the leaf sheaths and stalk. Eggs in a batch are slightly separated from one another. Eggs hatch about nine days after they have been laid. The larva pupates inside the hollowed out stalk. The pupal stage lasts about three weeks. Sorghum Stem Borer *Chilo partellus* is very similar to Maize stalk borer but less damaging.

Corn root aphid - *Anuraphis maidiradicis*

Infested crop germinates normally and reach a height of 10 to 25 cm, when growth becomes retarded. The aphid pierces roots with its needle- like mouth parts and extracts sap. As a result of aphids' feeding, the foliage develops a characteristic yellowish to reddish tinge before the corn is knee-high. Heavily infested seedlings rarely grow taller than 25 cm.

Maize aphid - *Rhopalosiphum maidis* (and other aphids)

Maize aphids commonly infest isolated plants but are rarely a problem in large fields of corn. Usually sucks on juices from the tassels and silk, on the leaves sheathing the cob, and with heavy infestations, the underside of leaves Green and dark green aphids are often found on corn. They are usually found in the leaf sheath or the underside of leaves. Aphids excrete honeydew, which is a sweet liquid that is eagerly sought by ants. Aphid infestations may be located through the presence of ants on the plants. A black fungal growth (called sooty mold) often occurs on the honeydew secreted by aphids. Other aphids such as black bean aphid are very similar in damage and location to maize aphid.

Colonies

Detail of a colony

Damage on a plant

VIRUSES

Maize Streak Virus

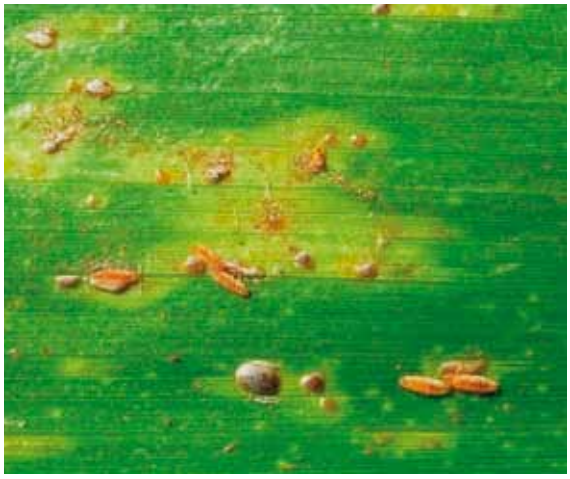
Transmitted by *Cicadulina* leafhoppers. The leaf hopper sucks the juices of leaves. Its main damage to the plant is to infect it with Maize Streak Virus which causes yellow streaks to appear on the leaf on either side of the main vein. Damage is mainly to plants younger than six weeks.

Streaks on leaves

FUNGI

Rouille commune - *Puccinia sorghi*

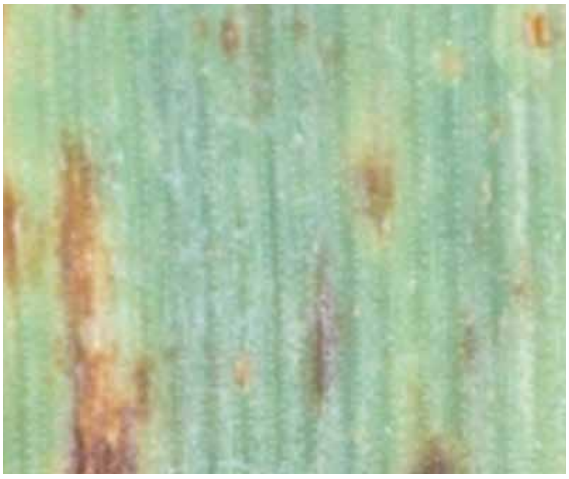
Produces characteristic brick-red pustules on the upper and lower leaf surfaces. Presence can be extensive and causes loss of photosynthetic area



Symptoms reduced by larvae of *Mycodiplosis* sp. grazing on rust pustules

Northern Leaf Blight – *Setosphaeria turcica (syn. Helminthosporium turcicum)* (anamorph. *Exserohilum turcicum*)

Severe leaf infection causes coalescing of lesions and grey appearance like frost or drought injury.



Symptoms

Grey (Gray) leaf spot – *Cercospora zeae-maydis*

The lower leaves of the corn plant are most often the sites of initial infections. When conditions are favourable for disease development, conidia are produced in lesions on the lower leaves and serve as inoculum for the upper leaves. If conditions are not favourable for disease, the fungus can remain "dormant" and then become active when favourable conditions return.

Ear and stem rots (Caused by various sp. e.g *Fusarium, Aspergillus*)

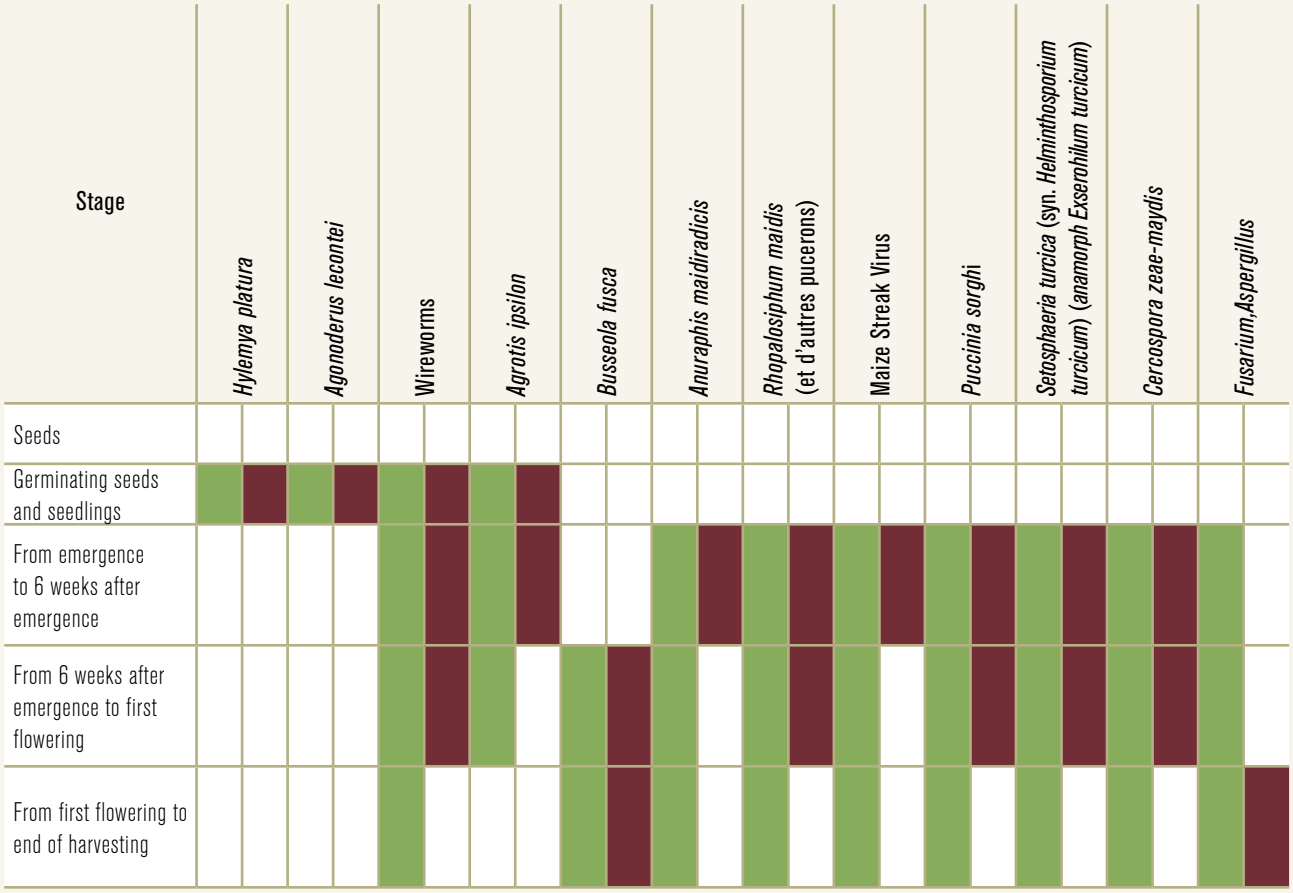
Fusarium and Aspergillus fungal infections are visible as black discolouration on the stem and ear. Streaks of black mycelium and conidia visible.

Aspergillus symptoms

Fusarium symptoms

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. The purpose is to show that the presence of a pest, disease or pathogenic agent is not always harmful to the crop. It is especially during the latter stages that they must be monitored and controlled if necessary.



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, ZIM = Zimbabwe, TAN = Tanzania, SEN = Senegal
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.

Seed corn Maggot - *Hylemya platura*

Favourable conditions : This pest may attack germinating seed planted in cool, wet weather.

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

Seed corn beetle - *Agonoderus lecontei*

Favourable conditions : All year round.

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

Wireworms – species of the order *Coleoptera*, family *Elateridae*

Favourable conditions : All year round, but moist soil required.

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

Black cutworm - *Agrotis ipsilon*

Favourable conditions : Warm dry conditions. Cool soil temperatures encourage feeding activity around the crop root zone.

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

Maize Stalk Borer - *Busseola fusca* (or African Stalk Borer)

Favourable conditions : All year round, but during and after rains.

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

Corn root aphid - *Anuraphis maidiradicis*

Favourable conditions : In dry weather but can be seen all year round.

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

Maize aphid - *Rhopalosiphum maidis* (and other aphids)

Favourable conditions : All year round, but worst in dry conditions and least in wet humid conditions.

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

Maize Streak Virus

Favourable conditions : All year round.

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

Common Rust - *Puccinia sorghi*

Favourable conditions : In humid and rainy weather, but seen all year round. Prevalent when wet weather is followed by dry weather.

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

Northern Leaf Blight – *Setosphaeria turcica* (syn. *Helminthosporium turcicum*) (anamorph *Exserohilum turcicum*)

Favourable conditions : In humid and rainy weather.

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

Grey leaf spot – *Cercospora zeae-maydis*

Favourable conditions : In humid and rainy weather. Grey leaf spot is a highly weather-dependent disease. The pathogen requires long periods of high relative humidity and free moisture (dew) on the leaves for infection to occur.

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

Ear and stem rots (Caused by various sp. e.g *Fusarium, Aspergillus*)												
Favourable conditions : In humid and rainy weather.												
Month	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
KEN	+	+	+	+	+	+	+	+	+	+	+	+
ZAM	+	+	+	+	+	+	+	+	+	+	+	+
ZIM	+	+	+	+	+	+	+	+	+	+	+	+
TAN	+	+	+	+	+	+	+	+	+	+	+	+
SEN	/	/	/	/	/	/	/	/	/	/	/	/

2. Main control methods

2.1. Introduction

Main principle to control pest and diseases on this crop use of selected cultivars that are shown to be tolerant to the major pests and diseases, the selective use of Plant Protection products (PPP) when scouting data has shown that it is necessary to spray, the encouragement of natural enemies by using compatible sprays and the use of cultural control methods such as crop rotation and tillage practices.

Rotation

Rotate corn with most other field crops like soybeans, cotton, tobacco, groundnuts, wheat and barley. Initial infection to diseases like grey leaf spot and northern leaf blight in rotated crops may be delayed by 2-3 weeks.

Tillage

Burial of corn residues, is beneficial in reducing pathogen survival and inoculum for the succeeding corn crop. 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 corn 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 grey leaf spot inoculum in regions where widespread use of conservation tillage is practiced because the pathogen may blow into a field from adjacent fields.

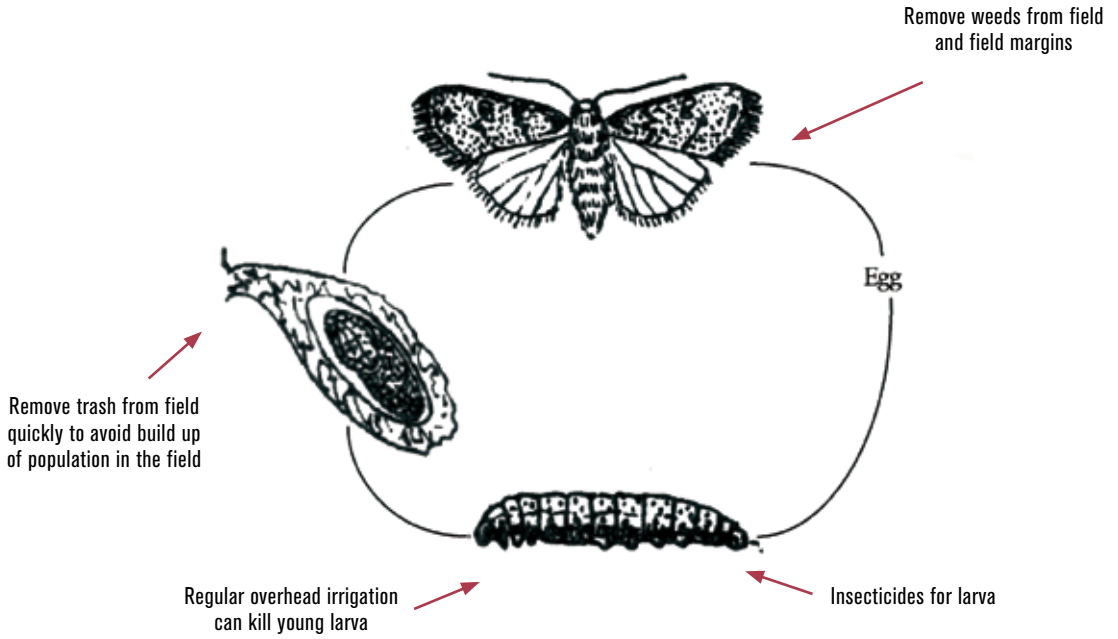
2.2. Pest or disease cycle; positioning of control methods and factors influencing development of the cycle

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.

NB : 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.

BLACK CUTWORM – *Agrotis* spp.

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

Before sowing and during crop development

- Good seedbed preparation and weed removal also near field margins help control cutworms. Reduced or no-till practices, may increase the risk of some insect damage especially after grass leys.

During sensible stage of the plant (see 1.3.)

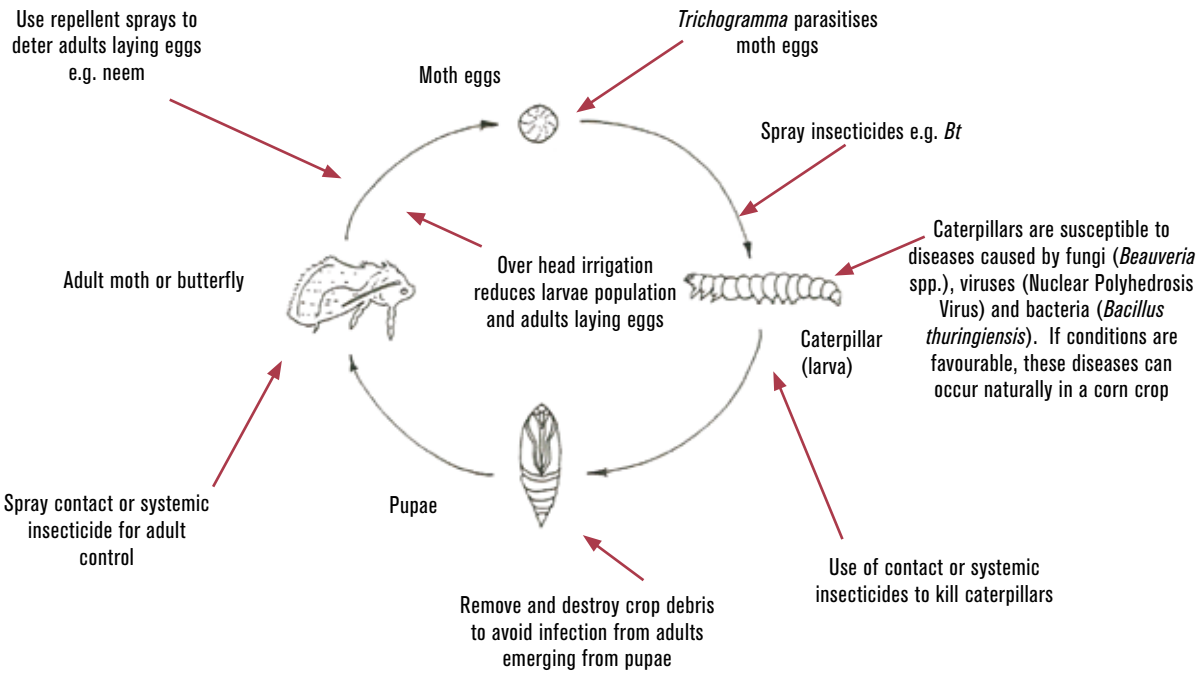
- Heavy irrigation or rainfall is a method of suppressing cutworm.
- Apply insecticides like pyrethroids at the first sign of damage.

After last harvesting

- Remove trash from field quickly to avoid development of population in the field.

MAIZE STALK BORER (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

From 6 weeks after plants emerging

- Repellant sprays such as those containing neem will deter adults coming into the crop. If only repellent and physical controls are used – it is likely that *Trichogramma* (parasite of caterpillar eggs) will establish naturally.
- Over head irrigation reduces larvae population and adults laying eggs.
- Use of contact or systemic insecticides to be used to kill adults.
- Early, prophylactic physical sprays (soaps and oils in alternate weeks) will suffocate caterpillar eggs.
- Use *Trichogramma* if available to control 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 last harvesting

- Remove and destroy crop debris to avoid infection from adults emerging from pupae and laying eggs on new or younger crops. Old stalks lying in the fields contain caterpillars/larvae/pupae so they need to be removed or ploughed deeply into the soil so that moths cannot emerge successfully.

APHIDS

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

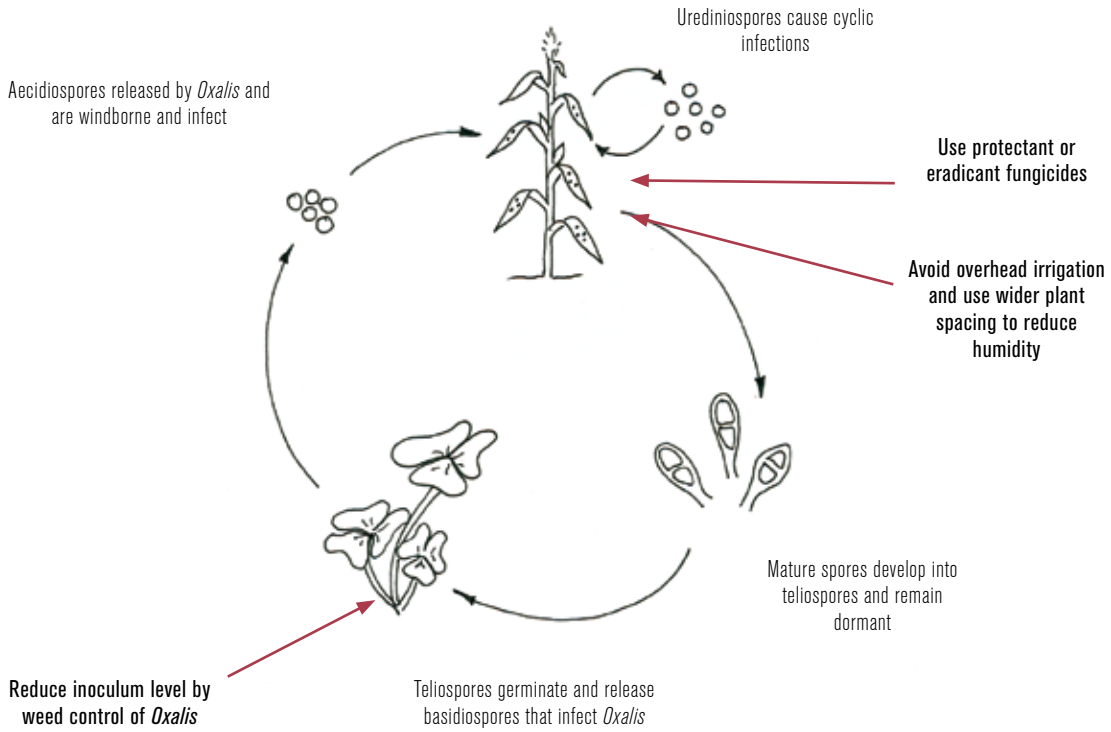
Positioning of control methods in terms of the development cycle of the plant

Field

- Apply insecticides as spot treatments to aphid colonies or overall crop sprays when appropriate. These can be applied at any stage of the life cycle as all stages of the life cycle are present at any one time.
- Use compatible insecticides such as physical oils or detergents to minimise the effect of insecticides on natural enemies like lady birds and *Aphidius* which parasitises aphids.
- Introduce natural enemies into colonies of the crop to allow multiplication.

RUST

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

- Remove *Oxalis* weeds, which are the alternative host to rust in corn.

During sensible stage of the plant (see 1.3.)

- Avoid overhead irrigation and use wider plant spacing to reduce humidity.
- Use protectant or eradicant fungicides when leaf area has excessive infection and weather remains wet and has high humidity that will continue damage.

After last harvesting

- Remove crop and source of inoculum as soon as final harvest.

OTHER MINOR PESTS AND DISEASES

Seed corn maggot

Problems due to seed corn maggot are generally worse on soils with decaying organic matter or when germination is delayed.

Grey Leaf Spot and Northern leaf blight

Fungus diseases may only survive from one season to the next on infected corn or maize debris. The fungus in the debris produces spores which may become airborne, in turn infecting other corn crops.

2.3. Resistant or tolerant varieties

There are no numerous reports of maize have less sensitive varieties to a range of pests and diseases. However for those varieties grown as baby corn no reports have been found for their adoption as being more or less susceptible to any pests or diseases. The Seed Company of Zimbabwe reports that the variety ZS206 has a very good tolerance to leaf blight but is susceptible to Grey Leaf Spot.

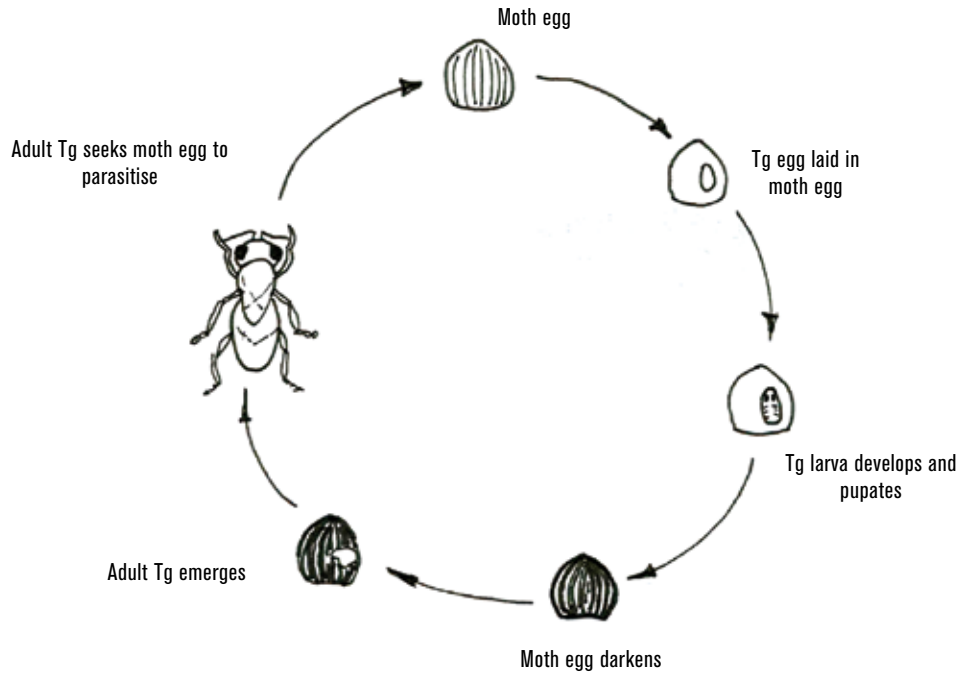
Maize has numerous examples of resistance to rust but none are reported for baby corn varieties.

2.4 Importance and use of auxiliaries

Natural enemies such as certain beetles, green lacewing and *syrphus* fly larvae can play the role of auxiliaries, preventing and limiting population explosions of certain pests. Broad-spectrum insecticides should therefore be avoided as much as possible. The use of selective active substances, when available, is preferred as a means of protecting natural enemies.

Explanations of the importance of natural enemies and ways of encouraging their presence can be found in documents especially dedicated to this matter. In the following some examples are described for the use of naturel enimies on different pests important for maize.

TRICHOGRAMMA (Tg) for moth control



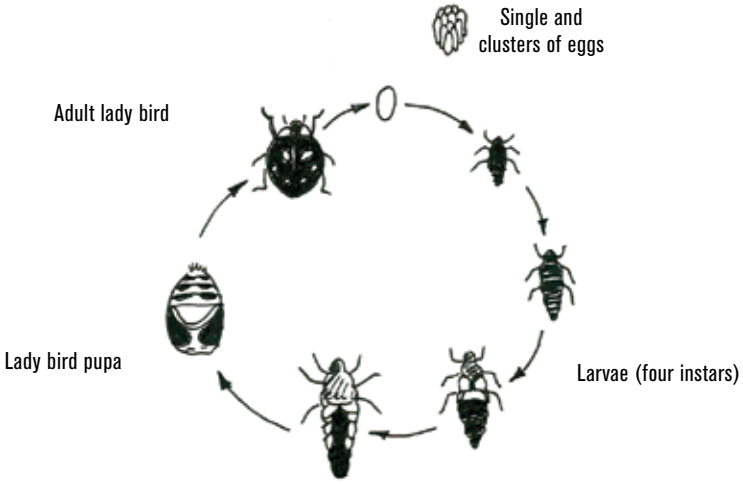
Trichogramma is a parasitic wasp that is widely used in the world to control stem borer. Wasps should be repeated released during the growth of the crop. The parasitic wasp lays the eggs inside the eggs of the moth. The egg develops as a larva inside the host egg and goes through four larval instars. When the larvae pupates the host egg turns black. The adult emerges from the host egg and further parasitism will be completed within two days of emergence.

APHIDIUS for aphid control

Mummified aphid showing the exit hole of the adult *Aphidius*

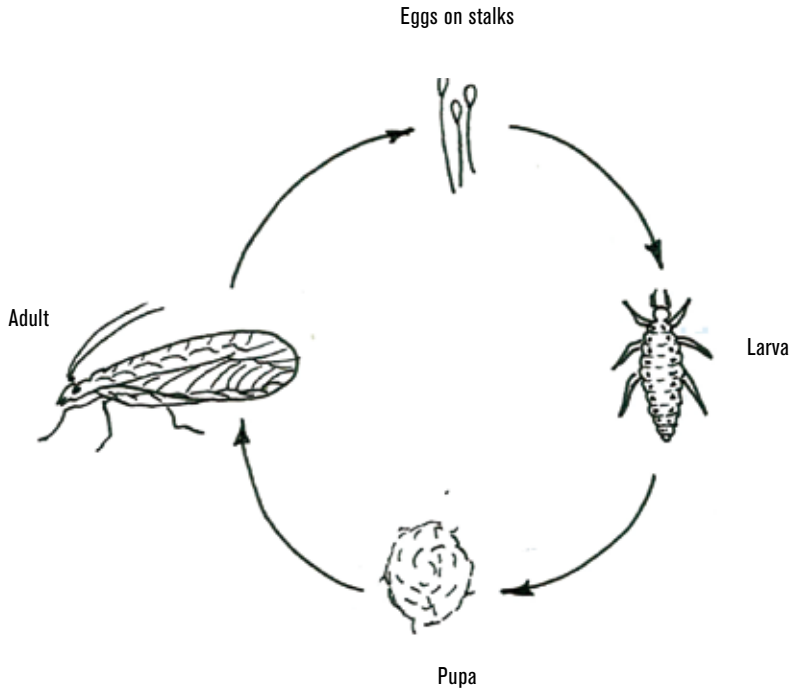
Aphids are parasitised by wasps, mainly in the genus *Aphidius*. The parasitism occurs spontaneously and is frequently seen in corn aphid colonies. The *Aphidius* adult searches out the aphid and lays her egg in the aphid in less than half a second. As the *Aphidius* larva begins to develop inside the aphid, the aphid swells, the cuticle turns to a hard, leathery brown to golden casing known as a mummy. The adult *Aphidius* emerges from the mummy through a round exit hole.

LADY BIRD *(Coccinellidae) for control of aphids*



Lady birds of which there are many species are important natural predators and are valuable as a natural supplement to insect control. Most lady birds eat aphids, with both the adult and all stages of larvae feeding on insects and mites. The larger larvae and adults consume the most aphids and they may consume many hundreds of aphids during their development. Adults have the disadvantage of flying away in sunny weather.

LACEWINGS for control of aphids



Lacewings get their name from the fine delicate lace like qualities of their wings. The most common type found is the green lacewing (*Chrysoperla carnea*) and mainly consumes aphids, though will eat other insects and mites. Only the larvae will consume the aphids, eating up to 400 during their development. Leaf hairs impair feeding efficiency and they are mainly active at night so rarely seen consuming aphids. The adult makes no contribution to biological control.

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

Growers should identify pests and diseases and inspect their crops regularly for all the species mentioned in this guide. It is easier to control infestations if they are detected at an early stage. It is recommended that growers visit their fields and count pests and auxiliaries at least twice a week.

General observation techniques are described in the COLEACP/PIP training.
Certain information is given below on the thresholds whose validity and relevance are to be checked in local conditions.

Farm		Block	
Crop age (WKS)		Date scouted	
Scout name (PRINT)			Time of day scouted
Pests			Diseases

Station	Seedcorn Maggot	Seedcorn beetles	Wireworms	Cutworm	Maize Stalk Borer	Corn root aphid	Maize aphid	*Aphidius*	Station	Maize Streak Virus	Common Rust	Grey leaf spot	Northern Leaf Blight	Ear and stem rots
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 / ears / stems per plant					

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

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 (see diagram for positions) 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 :

Seedcorn maggot	Calculate percentage loss and treat when above 1 %
Seedcorn beetles	Calculate percentage loss and treat when above 1 %
Wireworms	Calculate percentage damage and treat when above 1 %
Cutworm	At germination count total number of damaged plants, estimate % loss of plants in whole block, treat when above 1 %
Maize Stalk Borer	Calculate percentage found and treat when above 1 %
Corn root aphid	Calculate percentage damage and treat when above 10 %
Maize aphid	Examine 3 leaves per plant (6 /station), record the number of aphids and Calculate % infected.
Aphidius	Examine 3 leaves per plant (6 /station), record the number of *Aphidius* present Calculate % parasitism.

Diseases : Check both plants at each station - record number of diseased leaves/ears/stems on both plants.

Maize Streak Virus	No action, but record for future crops when seed dressing required.
Common Rust	Treat when 50 % of leaves infected.
Grey leaf spot	Treat when 25 % of leaves infected.
Northern Leaf Blight	Treat when 10 % of leaves infected.
Ear and stem rots	No action as if ears/stems affected too late to treat for this year. Note weather conditions and act at an earlier stage in future crops.

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 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.

4. Plant Protection Products and treatment recommendations

Introduction

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

A list of active substances and biocontrol agents is suggested for each pest or disease. When available, the critical Good Agricultural Practice (GAP) is also shown.

PHIs (Pre-harvest interval) are indicated for:

- Compliance with the European Maximum Residue Limits (MRLs) currently in force on spinach including amaranthus spinach (on products exported into the EU).
- Compliance with the CODEX MRL (for products sold in the countries where the CODEX MRLs are relevant).
- Special private standards, who allow harvested products without any quantifiable residues i.e. with "0" residues taking into account European LOQ.

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. These GAPs does not represent a treatment calendar to be applied as such. In practice, the frequency of treatments must take into account the severity of attacks and the real risks of local damage.

The GAPs highlighted in yellow was tested in Kenya in 2009 by PIP on baby-corn but not on sweet corn.
When there is intrinsically no residues issue for an active substance or a biological agent (highlighted in blue in the tables) the PHI is fixed by default to 2 days.

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. It is nevertheless worth noting that not all the ACP producers contacted provided information on the PPP used.

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 if high risk for resistance is possible.

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 impact on natural enemies.

Others substances act as a physical trap on some small insects, nematodes and fungus and are not considered like conventional Plant Protection Products. For instance propylene glycol alginate can trap small insects like aphids when applied correctly. This substance as no pesticide resistance and no residues of concern but one should check locally authorization for use on crops.

PIP updates quarterly on its website the compilation of GAPs (Good Agricultural Practice) taking into account changes in EU or Codex MRLs.

Cutworm and wireworms – *Agrotis ipsilon* and others

Strategy: curative applications should ensure that the soil surface is adequately wetted. Application of granules pre-sowing or pre-emergence is rarely effective. Treatments can be applied against first-stage larvae. The main treatment consists of curative sprays, but baits present less risk for the environment. If a seed treatment with imidacloprid has been made against other pests, it will also help control cutworms.

Active substance	Recommended GAP*						Proposed application period				
	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
				EU MRL	Codex MRL	LOQ					
Group 3 – Pyrethroids (sodium channel modulators)											
Cypermethrin	/	1	n.a.	***							
Alpha-cypermethrin	25	1	n.a.	***							
Deltamethrin	12	1	n.a.	***							
Lambda-cyhalothrin	7,5	1	n.a.	***							
Group 1 – Organophosphates and carbamates											
Chlorpyrifos-ethyl	/	1	n.a.	***							
Carbosulfan	2,5 - 5 g/kg seeds	1	n.a.	Seeds treatment							

* the elements of the recommended GAP shown here allow to comply with the harmonised European MRL the Codex MRL or the LOQ ("0" residues) - see part 6 of this guide)
** see introduction in part 4 of the Guide
*** applications of non systemic insecticides to control this pest are always done before flowering so there is no residues concern at harvesting
/ elements of the recommanded GAP not available

n.a. : not applicable

Caterpillars – *numerous*

Strategy: sprays should be applied against first-stage larvae. And repeat as required.

Active substance	Recommended GAP*						Proposed application period				
	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
				EU MRL	Codex MRL	LOQ					
Group 3 – Pyrethroids (sodium channel modulators)											
Deltamethrin	10	3	7	3	3	3			■	■	■
Alpha-cypermethrin	25	/	/	14	/	/			■	■	
Lambda-cyhalothrin	7,5	1	n.a.	3	3	3			■	■	■
Group 1 – Organophosphates and carbamates											
Methomyl	/	/	/	/	/	/			■		
Group 18 – Ecdysone aganists/moulting disruptors											
Indoxacarbe	424,5	/	/	/	/	/			■		

* the elements of the recommended GAP shown here allow to comply with the harmonised European MRL, the Codex MRL or the LOQ ("0" residues) - see part 6 of this guide
** see introduction in part 4 of the Guide
/ elements of the recommanded GAP not available

n.a. : not applicable

Stalk borer – *Busseola fusca*

Strategy: chemical control is only justified if more than 3 – 5 % of the stems are infested by the pest at the beginning of its mobile stages of the larvae. Against the first generation, two spray treatments should be applied within 15-20 days around the peaks of flight activity. Against the second generation, one treatment should be applied at the peak of flight activity.

Active substance	Recommended GAP*						Proposed application period				
	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
				EU MRL	Codex MRL	LOQ					
Group 3 – Pyrethroids (sodium channel modulators)											
Beta-cyfluthrin	2 g of formulated product***/plant in the whorl	1	n.a.	3 weeks after sowing semis							
Alpha-cypermethrin	12,5	/	/	14	/	/					
Deltamethrin	10	3	7	3	3	3					
Lambda-cyhalothrin	7,5	1	n.a.	3	3	3					
Group 1 – Organophosphates and carbamates											
Carbosulfan	/	/	/	/	/	/					

* the elements of the recommended GAP shown here allow to comply with the harmonised European MRL the Codex MRL or the LOQ ("0" residues) - see part 6 of this guide)
** see introduction in part 4 of the Guide
*** see table at he end of this part 4 of the Guide to know the formulated product to be used
/ elements of the recommanded GAP not available
n.a. : not applicable

Aphids – *Anuraphis maidiradicis* and others

Strategy : treatment for aphids is applied when a threshold is exceeded. Flowering is the most sensitive period for the crop, which should be monitored at tassel emergence, and a treatment applied if 50% of tassels are infested. Use of certain selective insecticides (e.g. pirimicarb) will favour natural enemies. If a seed treatment with imidacloprid has been made against other pests, it will also control aphids.

Active substance	Recommended GAP*						Proposed application period				
	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
				EU MRL	Codex MRL	LOQ					
Group 3 – Pyrethroids (sodium channel modulators)											
Deltamethrin	10	3	7	3	3	3					
Group 1 – Organophosphates and carbamates											
Pirimicarbe	375	2	10	3	3	3					

* the elements of the recommended GAP shown here allow to comply with the harmonised European MRL the Codex MRL or the LOQ ("0" residues) - see part 6 of this guide)
** see introduction in part 4 of the Guide
/ elements of the recommanded GAP not available
n.a. : not applicable

Leaf hopper – *Cicadulina* spp.

Strategy: vector of maize streak virus. Use seed treated with insecticide to control leaf hopper where virus is known to occur. Late virus infections not serious enough to warrant control.

Active substance	Recommended GAP*						Proposed application period				
	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
				EU MRL	Codex MRL	LOQ					
Group 4 – Nicotinic acetylcholine receptor agonists/antagonists											
Imidacloprid	/	1	n.a.	seed treatment							

* the elements of the recommended GAP shown here allow to comply with the harmonised European MRL the Codex MRL or the LOQ ("0" residues) - see part 6 of this guide)
** see introduction in part 4 of the Guide
/ elements of the recommanded GAP not available
n.a. : not applicable

Rust – *Puccinia sorghi*

Strategy: use fungicide sprays when first symptoms appear and weather conditions are conducive for development of disease. Rust usually does no occur in young newly emerged crops.

Active substance	Recommended GAP*						Proposed application period				
	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
				EU MRL	Codex MRL	LOQ					
Group M - Multi-site contact activity											
Copper hydroxide	2000	2	7	3	/	/					

Northern leaf blight – *Setosphaeria turcica* (syn. *Helminthosporium turcicum*) (anamorph *Exserohilum turcicum*)

Strategy: fungicide sprays can be applied. If the disease appears before growth stage "10 leaves", two applications are needed. No fungicides required after flowering.

Active substance	Recommended GAP*						Proposed application period				
	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
				EU MRL	Codex MRL	LOQ					
Group M - Multi-site contact activity											
Copper hydroxide	2000	2	7	3	/	/					

* the elements of the recommended GAP shown here allow to comply with the harmonised European MRL the Codex MRL or the LOQ ("0" residues) - see part 6 of this guide)
** see introduction in part 4 of the Guide
/ elements of the recommanded GAP not available
n.a. : not applicable

Grey leaf spot – *Cercospora zeae-maydis*

Strategy: fungicide sprays can be applied. If the disease appears before growth stage "10 leaves", two applications are needed. No fungicides required after flowering.

Active substance	Recommended GAP*						Proposed application period				
	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
				EU MRL	Codex MRL	LOQ					
Group 11 - Methoxyacrylates											
Azoxystrobine	250	2	10	3	3	3					
Group 3 - DMI fungicides											
Difenoconazole	125	3	14	3	3	3					

* the elements of the recommended GAP shown here allow to comply with the harmonised European MRL the Codex MRL or the LOQ ("0" residues) - see part 6 of this guide)
** see introduction in part 4 of the Guide
/ elements of the recommanded GAP not available
n.a. : not applicable

Sources of GAP validated by PIP trials (boxes highlighted in orange in previous pages)

Active subsance	Commercial product tested	Manufacturer	Trials	
			Year	Country
Azoxystrobine	Ortiva 250 SC	Syngenta	2009	Kenya
Beta-cyfluthrin	Bulldock 0.05 GR	Bayer CropScience	2009	Kenya
Deltamethrin	Decis 2.5 EC	Bayer CropScience	2009	Kenya
Difenoconazole	Score 250 EC	Syngenta	2009	Kenya
Copper hydroxide	Kocide DF 40%	DuPont	2009	Kenya
Imidacloprid	Gaucho 350 FS	Bayer CropScience	2009	Kenya
Lambda-cyhalothrin	Karate 5 EC	Syngenta	2009	Kenya
Pirimicarbe	Pirimor 50 DG	Syngenta	2009	Kenya

Note : GAPs indicated in previous pages are those corresponding to the PPPs listed above. User of this information should check if the product used is equivalent (same concentration and same type of formulation) to the reference product. If it is not the case, the indicated GAP could not be adequate.

5. Existing registrations in ACP countries

The registration status, known by the COLEACP/PIP, in some ACP countries is given below for active substances listed in this Guide.

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

For the Zimbabwe and Zambia, we currently have no information on existing registrations.

Kenya

Registered fungicides in Kenya

Active substance	Type of registration
Azoxystrobine	Maize
Difénoconazole	Maize

Registered insecticides in Kenya

Active substance	Type of registration
Beta-cyfluthrin	Maize
Carbosulfan	Maize
Chlorpyrifos-rthyl	Vegetables - Maize
Cypermrthrin	Vegetables - Maize
Deltamethrin	Vegetables - Maize
Imidacloprid	Maize seeds
Lambda-cyhalothrin	Vegetables
Methomyl	Vegetables
Pirimicarbe	Vegetables

Registered fungicides in Tanzania

Active substance	Type of registration
Azoxystrobine	Horticultural crops
Copper hydroxide	Horticultural crops
Difenoconazole	Horticultural crops

Registered insecticides in Tanzania

Active substance	Type of registration
Alpha-cypermethrin	Horticultural crops
Beta-cyfluthrin	Horticultural crops
Chlorpyrifos-ethyl	Horticultural crops
Deltamethrin	Horticultural crops
Imidacloprid	Horticultural crops
Indoxacarbe	Horticultural crops
Lambda-cyhalothrin	Horticultural crops
Pirimicarbe	Horticultural crops

Note : horticultural crop include vegetable and fruit tree

Registered insecticides and fungicides by the CSP (Comité Sahélien des Pesticides) : Burkina Faso, Cape-Verde, Gambia, Guinea-Bissau, Mali, Mauritania, Niger, Senegal and Chad

Active substance	Type of registration
Chlorpyrifos-ethyl	Vegetables
Difenoconazole	Seeds
Lambda-cyhalothrin	Vegetables
Imidacloprid	Seeds

6. Regulations and pesticide residues

Status of the active substances in Regulation 1107/2009; European MRL and Codex MRL in November 2011

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

Active substance	European regulation		Codex MRL for Sweet corn (corn-on-the-cob)*
	Status Reg 1107/2009	MRL for sweet corn*	
Alpha-cypermethrin	Approved	0,05**	0,05**
Azoxystrobine	Approved	0,05**	/
Bacillus thuringiensis	Approved	n.a.	n.a.
Beta-cyfluthrin	Approved	0,02**	/
Carbosulfan	Not approved	0,05**	/
Chlorpyrifos-ethyl	Approved	0,05**	0,01**
Copper	Approved	10	/
Cypermethrin	Approved	0,05**	0,05**
Deltamethrin	Approved	0,05**	0,02**
Difenoconazole	Approved	0,05**	/
Imidacloprid	Approved	0,1	0,02**
Indoxacarbe	Approved	0,02**	0,02**
Lambda-cyhalothrin	Approved	0,05	/
Methomyl	Approved	0,02**	/
Pirimicarbe	Approved	0,5	/

Approved active ingredient approved for use in EU countries.
Not approved active ingredient not authorized in EU countries but usable in countries out of EU if the EU MRL are respected for the imported products in EU.
* apply also foe baby-corn
** LOQ value
n.a. = not applicable
/ doesn't exist or not available

Note on the status of active substances in EU

Before a Plant Protection Product can be marketed in EU, its active substance must be approved by the European Commission. Regulation (EC) 1107/2009 (replacing former "Directive 91/414/EEC") came into force on 14th June 2011. By 25th May 2011 the Commission adopted the Implementing Regulation (EU) N° 540/2011 as regards the list of approved active substances. These Regulations and all other related Regulations can be accessed using the search facility on the following: http://ec.europa.eu/food/plant/protection/evaluation/index_en.htm

It should be noted that if an active substance is not registered in the EU it can still be used in the ACP countries in food items exported to Europe, provided the residue complies with the EU MRL.

Note on MRLs:

The quantities of pesticide residues found in food must be safe for consumers and remain as low as possible.

The maximum residue limit (MRL) is the maximum concentration of pesticide residue legally permitted in or on food or feed.

MRLs in the EU

Pursuant to Regulation (EC) No 396/2005 harmonized Community MRLs have been established.

The European Commission (EC) sets MRLs applying to foodstuffs marketed in the territories of the EU countries, either produced in the EU or in third countries.

Annex I to the Regulation contains the list of crops (Regulation (EC) 178/2006) on which MRLs are assigned, Annexes II and III contain the MRLs: temporary MRLs can be found in Annex III, final MRLs in Annex II. Substances for which an MRL is not required are listed in Annex IV (Regulation (EC) 149/2008). When there is no specific MRL for a substance / crop a default MRL, usually set at 0.01 mg/kg, is applied.
When establishing an MRL, the EU takes into account the Codex MRL if it is set for the same agricultural practices and it passes the dietary risk assessment. Where appropriate Codex MRLs exist, the import tolerance will be set at this level.
EU harmonized MRLs came into force on 1 September 2008 and are published in the MRL database on the website of the Commission http://ec.europa.eu/sanco_pesticides/public/index.cfm

See also the leaflet "New pesticide residues in food" http://ec.europa.eu/food/plant/protection/pesticides/explanation_pesticide_residues.pdf

How are MRLs applied and monitored in EU?

- Operators, traders and importers are responsible for food safety, and therefore for compliance with MRLs.
- The Member State authorities are responsible for monitoring and enforcement of MRLs.
- To ensure the effective and uniform application of these limits, the Commission has established a multiannual Community monitoring program, defining for each Member State the main combinations of crops and pesticides to be monitored and the minimum number of samples to be taken. Member States must report results to the Commission, which published an annual report. At present the reports are published by the European Food Safety Authority (EFSA) http://www.efsa.europa.eu/en/scdocs.htm
- In case of detection of pesticide residue levels posing a risk to consumers, information is transmitted through the Rapid Alert System for Food and Feed (RASFF) and appropriate measures are taken to protect the consumer. The database is accessible on http://ec.europa.eu/food/food/rapidalert/rasff_portal_database_en.htm and RASFF publishes an annual report http://ec.europa.eu/food/food/rapidalert/index_en.htm.
- PIP monthly updates on its website a summary of RASFF notification for fruit and vegetable imports from ACP countries.

MRLs in ACP countries – Codex

The Codex Alimentarius Commission was established in 1961 by the Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) with the objective to develop an international food code and food standards. Membership of the Codex Alimentarius Commission is open to all Member Nations and Associate Members of FAO and WHO. More than 180 countries and the European Community are members of the Codex Alimentarius Commission.

The Joint FAO/WHO Meetings on Pesticide Residues (JMPR) is not officially part of the Codex Alimentarius Commission structure, but provide independent scientific expert advice to the Commission and its specialist Committee on Pesticide Residues for the establishment of Codex Maximum Residue Limits, Codex MRLs for pesticides which are recognized by most of the member countries and widely used, especially by countries that have no own system for evaluating and setting MRLs.

The Codex MRL database can be found on the web site: http://www.codexalimentarius.net/pestres/data/index.html?lang=en.

References, Websites and useful documents

1. References and useful documents

Anon (2002). Compendium of Corn Diseases (3rd) Edition). The Amerciuan Phytopathological Society, Minnesota, USA
Anon (2006). Corn: UC IPM Pest Management Guidelines. University of California, Publication Number 3443
Anon (2007). Small grains: UC IPM Pest Management Guidelines. University of California, Publication Number 3466

2. Useful web-pages

University of California, IPM online, Statewide integrated Pest Management programme.
http://www.ipm.ucdavis.edu/PMG/selectnewpest.corn.html

IPM FACTS - Index of Fact Sheets From MSU Extension
http://web1.msue.msu.edu/iac/fielcorn.html

University of Delaware – IPM Field Crops
http://ag.udel.edu/extension/IPM/info/fieldcrops.html

University of Illinois - Sweet Corn
http://www.ipm.uiuc.edu/fr-veg/vegetable/sweetcorn.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.)

PIP
FOR SUSTAINABLE DEVELOPMENT OF THE ACP HORTICULTURAL INDUSTRY

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