PIP

GUIDE TO GOOD CROP PROTECTION PRACTICES

FOR THE LYCHEE (*LITCHI CHINENSIS*) IN ACP COUNTRIES

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

PIP is funded by the European Union.

This publication has been produced with the assistance of the European Union. The contents of this publication are the sole responsibility of PIP and COLEACP and can in no way be taken to reflect the views of the European Union.

April 2011.

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

Document drawn up by PIP with the technical collaboration of:
AG-TECH Consult

Pictures credits:

- CTHT, rapport de synthèse – Ravageur et maladie du litchi – mars 2005
- Hawaii Pest and Disease Image Gallery : http://www.ctahr.hawaii.edu/nelsons/Misc/
- http://www.montpellier.inra.fr/
- http://www.inra.fr/hyppz/pa.htm
- Christian Didier, Jean-François Veyssières : Fiches maladies et ravageurs - Coleacp/PIP
- CABI
- http://www.fredon-corse.com/
- http://www.tlsh.tp.edu.tw/
- http://www.gov.mu/portal/sites/ncb/moa/farc/amas2005/presen/Session%2009/S9.4.pdf
- fotolia.com

Notice

The Guide to Good Plant Protection Practices (fruit or vegetable) details all plant protection practices (for fruits or vegetables) and recommends primarily the active substances supported by pesticides manufacturers in the framework of EU Directive 91/414, and from 14 June 2011, under the Regulation 1107/2009 replacing the Dir. 91/414/EC which must comply with standards for pesticide residues. Currently, these active substances have not been tested by PIP in ACP countries to check their conformity with MRLs. The information given on the active substances suggested is therefore changeable and will be adapted on an ongoing basis in accordance with the new information collected by PIP.

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

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

PIP
FOR SUSTAINABLE DEVELOPMENT OF THE ACP HORTICULTURAL INDUSTRY

Table of content

1. Main pests and diseases

1.1. Extent and impact on the quantity and quality of produce

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 produce and consequently end up causing a loss of financial income. The presence of pests and diseases can reduce yield and cause losses at different levels: fewer plants per hectare, lower number of fruits per plant, smaller size of fruits, lower quality product.

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

INSECTS							
Extent	Organs attacked				Types of loss		
	Branches and trunk	Leaves	Inflorescences	Fruits	Number of fruits / plant	Size of fruits	Quality of fruits at harvesting
Seychelles scale - *Icerya seychellarum*							
+	Puncture the plant on the underside of the leaves, on branches and fruit-bearing stem				Reduction by weakening due to reduced photosynthesis or a desiccation		
Aphid - *Toxoptera aurantii*							
+		Suck mainly the young shoots	Can also suck the flowers		Reduced if trees are weakened by a large number of aphids or sooty mould. Flowers shedding if inflorescences affected.		
Fruit flies QO - *Ceratitis capitata, Ceratitis rosa, Bactrocera cucurbitae, Bactrocera dorsalis*							
A great quantity of eggs can be laid in the pulp of the fruits, but few larvae appear at harvesting time.							
+				Larvae enter into the fruits			External punctures and damaged pulp
Thrips - *Selenothrips rubrocinctus* QO (Red ribbon thrips), *Heliothrips haemovoidalis* (Greenhouse thrips), *Frankliniella cephalica* (Florida flower thrip)							
+		Larvae and adults gnaw leaves and/or flowers according to the species				Possible reduction by less photosynthesis	
Trunk borer - *Chlumetia transversa* (= *Salagena transversa*)							
++	Larvae eat the bark and the wood of the trees				Reduction by lowering of the number of branches bearing fruits		

INSECTS (continued)							
Extent	Organs attacked				Types of loss		
	Branches and trunk	Leaves	Inflorescences	Fruits	Number of fruits / plant	Size of fruits	Quality of fruits at harvesting
Caterpillar (Fruit borer) - *Cryptophlebia peltastica* and *Cryptophlebia ombrodelta*							
++				The neonatal caterpillar penetrates the kernel. A lesion appears and paves the way for other parasites, especially fungi and *Drosophila*	Reduction due to fruits shedding		Fruits unmarketable due to the presence of brown spot on the shell with sap exudate Further losses if damaged fruits are packed with healthy fruits for shipment
Weevil - *Cratopus angustatus* and *Cratopus humeralis*							
++	Cut out or totally eaten by adults	Fruit-bearing stems gnawed by adults	Young fruits gnawed	Up to 10% of fruits-bearing stems attacked			Depreciation if fruits gnawed at first stage

MITES							
Extent	Organs attacked				Types of loss		
	Branches and trunk	Leaves	Inflorescences	Fruits	Number of fruits / plant	Size of fruits	Quality of fruits at harvesting
Aceria litchii (*Eriophyas*) or Erinose							
In the nursery, plants could die if too much leaves fall due to mites presence.							
+++		Larvae and adults develop on the underside of leaves, inflorescences and sometime fruits			Damaged tips of leaves and or direct damages on flowers may affect fruit setting	If damages are severe on leaves, they may fall prematurely and affect the size of fruits	

FUNGAL DISEASES							
Extent	Organs attacked				Types of loss		
	Branches and trunk	Leaves	Inflorescences	Fruits	Number of fruits / plant	Size of fruits	Quality of fruits at harvesting
Anthracnose - *Colletotrichum gloeosporioides*							
++		Mycelium develop on these organs					Fruit decay
Post harvest - *Alternaria* sp., *Aspergillus* sp., *Botryodiplodia* sp. *Penicillium* sp., *Rhizopus* sp. and various yeasts							
++				*Penicillium*, *Rhizopus* and *Aspergillus* enter through injuries at harvest or after harvest *Botryodiplodia* infect fruits on the tree or through the cut stalk at harvesting or after harvest			Fruit decay

ALGAE							
Extent	Organs attacked				Types of loss		
	Branches and trunk	Leaves	Inflorescences	Fruits	Number of fruits / plant	Size of fruits	Quality of fruits at harvesting
Cephaleuros spp.							
This alga could lead to less vigorous trees.							
+	Covered by microscopic spores with a rust colour				Possible reduction on less vigorous trees if heavily infected		

VERTEBRATES							
Bats							
++			Eaten by the bats		Reduction since inflorescences and fruits are eaten		Damaged fruits

PHYSIOLOGICAL DISORDERS							
Post harvest browning							
+++				Physiological modification after harvest			browning and cracking of the husk post harvest

1.2. Identification and damage

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

INSECTS

Seychelles scale - *Icerya seychellarum*

The Seychelles Scale can infest the fruits, leaves, stems, branches and trunk. In large numbers, this pest causes the leaves and branches to dry out. Yellow spots as opposed to "stings" generally appear on the leaves. Fumagine (sooty mould) is often associated with Seychelles Scale infestation. It forms on the lower surface of the leaves as well as on the branches and peduncles or fruit-bearing scapes, where it is most apparent.

Icerya seychellarum on a leave

Icerya seychellarum on a branch

Icerya seychellarum

Icerya seychellarum

Black Citrus Aphid, Coffee Aphid - *Toxoptera aurantii*

Groups of *Toxoptera aurantii* nymphs and adults can be seen on young shoots. They are blackish brown in colour. The insects suck the sap, causing leaf deformity, and produce a sugary substance, which falls on the leaves and underlying shoots. Sooty mould (*Capnodium* spp.) forms on this substrate.

Toxoptera aurantii: winged and apterous

Toxoptera aurantii: adults and larvae

Fruit Flies - *Ceratitis capitata, Ceratitis rosa*

Lychee fruit is considered virtually immune to attacks by the fruit fly. Damage due to secondary fruit fly infections has nevertheless been reported. Despite the fact that the fruit fly can deposit a large number of eggs in the flesh of the fruit, few larvae appear between laying the eggs and consumption of the fruit.

Other species cited:

Bactrocera cucurbitae (Melon Fly) is associated with lychee fruit whereas *Bactrocera dorsalis* (Oriental Fruit Fly) tends to be associated with both lychee and longan fruit.

The Madagascan Fruit Fly: *Ceratitis malgassa* (Tephritidæ). Hardly any traces of this insect are found on the lychee during harvesting.

Ceratitis capitata

Pupae of *Ceratitis capitata*

Ceratitis rosa

Thrips	*Selenothrips rubrocinctus* (Red ribbon thrips) *Heliothrips haemovoidalis* (Greenhouse thrips) *Frankliniella cephalica* (Florida flower thrip) In India : *Dolicothrips indicius* *Magalurothrips usitatus* *Magalurothrips distalis*

These are tiny, slender, fragile insects with two pairs of broadly fringed wings on reaching the adult stage. The nymphs and adults scratch the surface of the flowers or leaves, and suck the sap that oozes from the lesion. Thrips attack the tips of the leaves and flowers causing these parts of the plant to roll up and dry out. Some species of thrips attack the leaves and others the flowers.

Selenothrips rubrocinctus male

Trunk (Shoot) Borer - *Chlumetia transversa* (= *Salagena transversa*)

The caterpillars feed on the bark and wood of both young and mature trees. The affected tree does not perish but the branches fall off when the bark is girdled. The cream-coloured eggs are laid in piles on the bark of the branches. Incubation takes a few weeks, and the emerging larvae bore into the wood near the branches. The galleries, which are 70 mm long and 5 mm in diameter, act as a shelter for the larvae.
The larvae are 14 -18 mm long and pink in colour with dark markings. The adults have very attractive wings. They have a wing span of 11-13 mm and overwinter in the larval stage.

Damage of *Salagena* on main branch

Chlumetia tranversa

Caterpillar (Fruit borer): *Cryptophlebia peltastica* and *Cryptophlebia ombrodelta*

The female lays an egg on the shell of fruit that is often still unripe. The neonatal caterpillar penetrates the kernel through the shell: micronecrosis appears at the point of entry in the pulp, manifesting as a brown spot on the shell with sap exudate of varying intensity. This lesion paves the way for other parasites, especially fungi and *Drosophila* (fruit flies). Secondary rotting also occurs and may extend to adjacent fruit. The young caterpillar continues to bore towards the kernel where it settles and spends the final larval stages.

Adult

Larva

Symptoms on young fruits

First symptoms of damage on a fruit

Cratopus angustatus and *Cratopus humeralis*

The damage is characterised by serrated or sometimes completely gnawed leaves. The damage can also affect the floral and fruit scapes (after cluster formation). The fruit may also be gnawed, and is mostly damaged or destroyed in the early stages of its development.

Damage of weevils on leaves

Adult *Cratopus angustatus*

MITES

Aceria litchii

Aceria litchii (*Eriophyas*) or the Erinose mite destroys the ends of the leaves. The affected leaves no longer develop normally and may fall off prematurely if severely attacked. The young plants in the nurseries are extremely sensitive. They may even perish following excessive leaf loss.
The small (0.04 mm in diameter), round, whitish eggs are deposited on sprouting leaf buds. The nymphs appear 3-4 days later. Even at this stage, they are still small (0.15-0.2 mm), transparent and pink in colour with two pairs of legs positioned at the anterior extremity of the body.
Both nymphs and adults are generally found on the underside of the pubescences underneath the leaves. They damage the leaves by piercing and tearing the tissue and sucking the sap. Velvet-smooth, chocolate brown-coloured swellings on the lower surface of the leaves and leaf curl are typical signs of *Aceria litchii* infestation . During the initial stages, small, brown hollows appear in line with the swellings. On touching, the tips of the leaves curl up to form a cylinder. Leaf curl (blisters) appear(s) underneath the leaves. The leaves eventually suffer necrosis and fall off. Meanwhile, the pest has migrated towards other sections of the tree. The attack generally begins in the lower sections of the tree, rising gradually.

Aceria litchii on inflorescences

Symptoms on underside of leaves

In Madagascar *Oligonychus thelytokus* (Tetranychidæ) **is present**

Oligonychus thelytokus

FUNGAL DISEASES

Anthrachnose - *Colletotrichum gloeosporioides*

Anthracnose is caused by *Colletotrichum* gloeosporiodes and attacks both the leaves and the fruit, which are sensitive from flowering to the mid-growth stage. Most of the rot found in mature fruit comes from the infection of young fruit. The small spots develop into large, brown spots indicative of fruit rot. Finally, a white mycelium appears on the fruit during storage.

Brown spots on fruits

Post harvest

The pathogens responsible for rot include *Alternaria* sp., *Aspergillus* sp., *Botryodiplodia* sp., *Rhizopus* sp., *Penicillium* sp., *Colletotrichum* sp. and various yeasts.

ALGAE

Cephaleuros spp.

Cephaleuros mycoides and *Cephaleuros virescens*, which are parasites infesting several fruit crops including lychee, manifest by greyish green, circular rings on the leaves.

These algae can also produce rust-coloured, microscopic spores on the leaf surface, giving the leaves a reddish appearance. In severe cases, the substance covers the main branches.

VERTEBRATES

Bats

Bats cause direct losses by feeding on the fruit and inflorescences. However, they also trigger indirect losses when they damage the fruit. Considerable losses can be sustained since a fruit-eating bat can consume its own weight in fruit each night, whereas bats that feed on nectar can destroy several inflorescences on each visit.

PHYSIOLOGICAL DISORDERS

Post-harvest browning

Left at room temperature, the fruit changes very quickly. Within 2 to 3 days, the shell turns brown, dries out and cracks. Discolouration is due to oxidation of the anthocyanic pigments. The fruit is thus more sensitive to bursting and to secondary fungal contamination.
Browning can also be linked to non-enzymatic phenomena (Maillard oxidation), which are exacerbated by bacterial attacks and lesions due to insects, heat, physiological stress and the presence of ethylene.

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.

Stage	Length of stage	Scales		Aphis		Fruit flies		Thrips		*Salagena* sp., *Chlumetia* sp.		*Cryptophlebia peltastica* and *Cryptophlebia ombrodelta*		*Cratopus angustatus* and *Cratopus humeralis*		*Aceria litchii*		*Colletotrichum gloeosporioides*		*Cephaleuros* spp.		Bats	
Vegetative growth	10 – 12 weeks																						
Dormancy	12 - 14 weeks																						
Flowering	8-10 weeks																						
Fruits setting	4-6 weeks																						
Fruit enlargment	8 - 10 weeks																						
Ripeness	4 weeks																						

Periods during which pests and pathogenic agents are 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

Due to the lack of information on the dynamics of the populations for pests and diseases of lychee, we give in this Guide only the relative importance per country.

Key:
0 = no damage
+ = limited damage
++ = average damage: control necessary
+++ = heavy damage: control essential
/ = 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.

Seychelles scale - *Icerya seychellarum*		
Favourable conditions : No data available.		
Madagascar : +	Mauritius : x	Mozambique: /
Aphids - *Toxoptera aurantii*		
Favourable conditions : A rainy season after a dry weather is favourable to the proliferation of this pest. Optimal temperature is between 20 and 25°C. Cold weather, and above all hot weather (above 30°C) slow down the development of the aphids.		
Madagascar : x	Mauritius : x	Mozambique : /
Fruit flies - *Ceratitis* spp.		
Favourable conditions : The development of the fruit fly is highly dependent to the thermics conditions : optimum temperature is around 32 °C, at this temperature the life cycle is achieved in 2 weeks.		
Madagascar : x	Mauritius : ++	Mozambique : /
Thrips		
Favourable conditions : Thrips prefer a dry and hot weather. The population is usually low during the rainy season.		
Madagascar : /	Mauritius : x	Mozambique : /
***Salagena* (*Chlumetia*) sp.**		
Favourable conditions : No data available.		
Madagascar : x	Mauritius : +++	Mozambique : /
Cryptophlebia peltastica* and *Cryptophlebia ombrodelta		
Favourable conditions : No data available.		
Madagascar : x	Mauritius : +++	Mozambique : /
Cratopus angustatus* and *Cratopus humeralis		
Favourable conditions : More present during the cool season and in orchard at high altitude.		
Madagascar : +++	Mauritius : x	Mozambique : /
Aceria litchii		
Favourable conditions : The mite is dispersed by wind, birds and other animals. The adult is in dormancy during cold season and start to reproduce when the weather become less cold.		
Madagascar : x	Mauritius : /	Mozambique : /

Oligonychus thelytokus		
Favourable conditions : No data available.		
Madagascar : x	Mauritius : /	Mozambique : /
Colletotrichum gleosporioides		
Favourable conditions : High humidity (irrigation, dew) and temperatures around 20° C.		
Madagascar : +	Mauritius : /	Mozambique : /
Post harvest diseases		
Favourable conditions : Heat, humidity and lack of ventilation.		
Madagascar : /	Mauritius : /	Mozambique : /
Cephaleuros spp.		
Favourable conditions : In very humid area.		
Madagascar : +	Mauritius : /	Mozambique : /
Bats		
Favourable conditions : Level of damages greatly vary from one region to another and is usually more important during summer season when females breast-feed the young bats.		
Madagascar : /	Mauritius : +++	Mozambique : /
Post harvest browning		
Favourable conditions : No effect of weather conditions		
Madagascar : +++	Mauritius : +++	Mozambique : +++

2. Main control methods

2.1. Introduction

General information on pests and diseases control:

Fruit trees are subject to attack from a large number of pests and diseases, some of which are very serious since they can lead to the death of the tree, and others that are difficult to control.

Although many parasites attack the lychee, few of them actually cause extremely severe damage. As the lychee is highly sensitive to numerous insecticides, fungicides and adjuvants, Plant Protection Products (PPP) should not be used in such cases to control pests and diseases. PPPs remain an indispensable tool for combating certain pests and diseases, but they should be applied alongside other methods, such as the use of resistant varieties or methods of cultivation.

The working of the soil post-harvest destroys some of the pests, one of the development stages of which occurs in the soil. The destruction of wood shavings and organs that have fallen on the ground can also reduce the sources of infestation of certain pests and diseases.

Tree protection involves a number of techniques, all of which are fundamental:

- healthy selection of plant material (healthy variety and stock);
- choice of variety and stock (less sensitive to disease);
- choice of site (an environment that is not conducive to diseases);
- use of PPPs: to be used only as a last resort.

In cases where PPPs are used, optimum results will be obtained if the following approach is adopted:

- correctly identify the disease or pest to be controlled;
- estimate the extent of the attack (concept of tolerance threshold) to determine whether or not treatment is required;
- choose the right product and be as selective as possible in order to preserve the beneficial effect of useful insects inhabiting the orchard (bees, ladybirds and chrysops, etc.). Similarly, if applied during the flowering season, products that are harmless to pollinating insects will be chosen;
- at the very least, treatment efficacy depends as much on good distribution – quantity of spray, rate of application of the active substance and the quality of the spraying technique – as on the specific efficacy of the product used;
- only products licensed for the crop in question and intended for a specific use will be selected.

Comments: There is evidence of parasite resistance to the products used to control these pests. To prevent the ensuing loss of efficacy, products belonging to different chemical families should be used in succession to eliminate the same parasite, even if some of these products vary in terms of efficacy. This applies in particular during the repeated application of plant protection products to control pests with a short life cycle and many generations in close succession (aphids, thrips and mites).

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

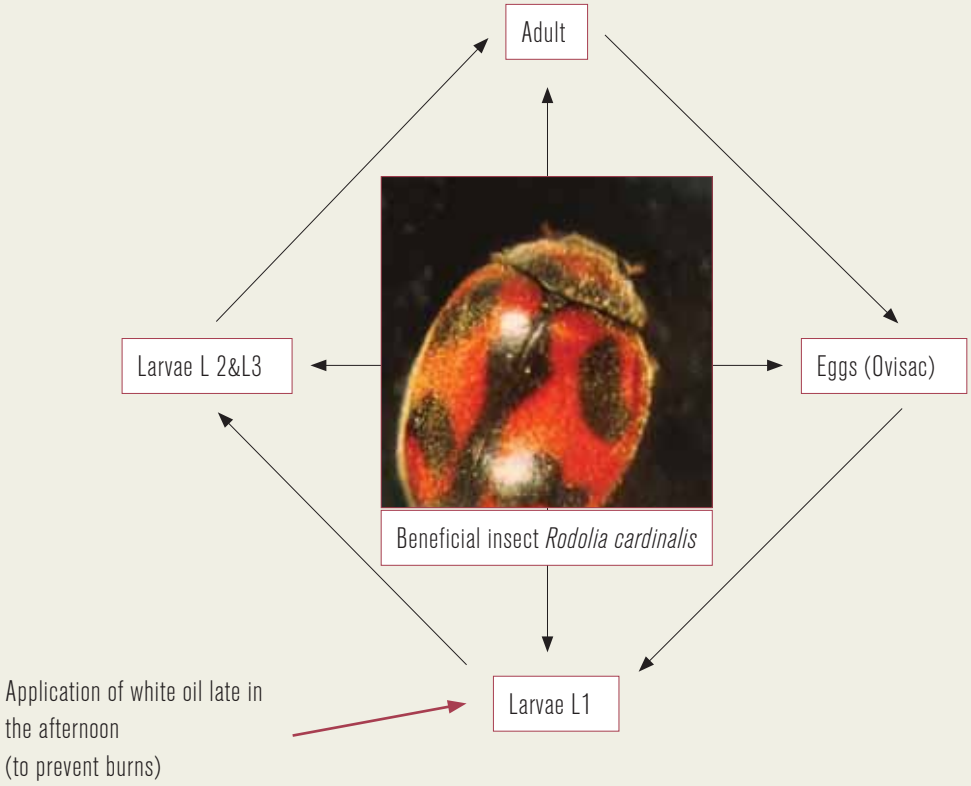
Based on the stages of development of each pest or disease, the following are the applicable control methods, as well as the effects of natural factors other than those related to climate, which are described in Part 1.4. of this guide. The control methods are then positioned in terms of the plant's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

SEYCHELLES SCALE - *ICERYA SEYCHELLARUM*

Position of control methods on the life cycle of the pest

Ants protect Seychelles Scale against its natural predators. Ant control can, therefore, indirectly reduce the Seychelles Scale population.



Position of control methods on the life cycle of the plant

During the production cycle, as soon as the Seychelles Scale appears, during the sensitive stages of the plant

- Application of a high volume of oil-based treatments (asphyxiating effect on L1). Intervention is required at the L1 larvae swarming stage, which is the only stage during which the insect is sensitive to treatments because it is not protected by its defence mechanisms/shield.
- Predators (*Rodolia cardinalis* for instance) are effective against all the stages in the Seychelles Scale life cycle.
- Parasites such as *Cryptochetum monophlebi* are also used to reduce the Seychelles Scale population.

APHID *(TOXOPTERA AURANTII)*

Position of control methods on the life cycle of the pest

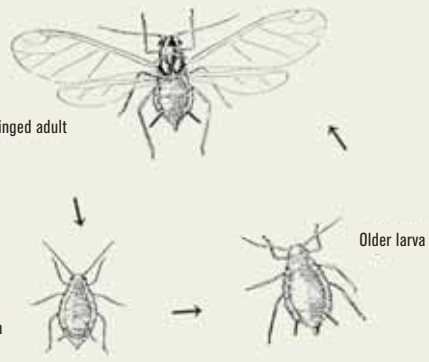
Plants must be regularly examined to see if the pest is present.
Preference should be given to specific insecticides in order to reduce the impact of insecticidal treatments on beneficial insects (ladybirds and hoverflies).

Install yellow sticky traps or water traps in the cultivation plot

Insect-repellent net to cover young plants (nursery)

Repulsive plants to keep the adult insects away from the crop

Elimination of host plants near the orchard



To ensure control at all stages
- Natural shelters to encourage natural enemies, e.g. Coleoptera and hoverflies, *Aphidius*
- Use of selective insecticides
- Natural enemies: hymenopterae parasites, predators (ladybirds, hoverflies, chrysops)
- Controls ants in the orchard because they will disrupt the activities of natural enemies

Position of control methods on the life cycle of the plant

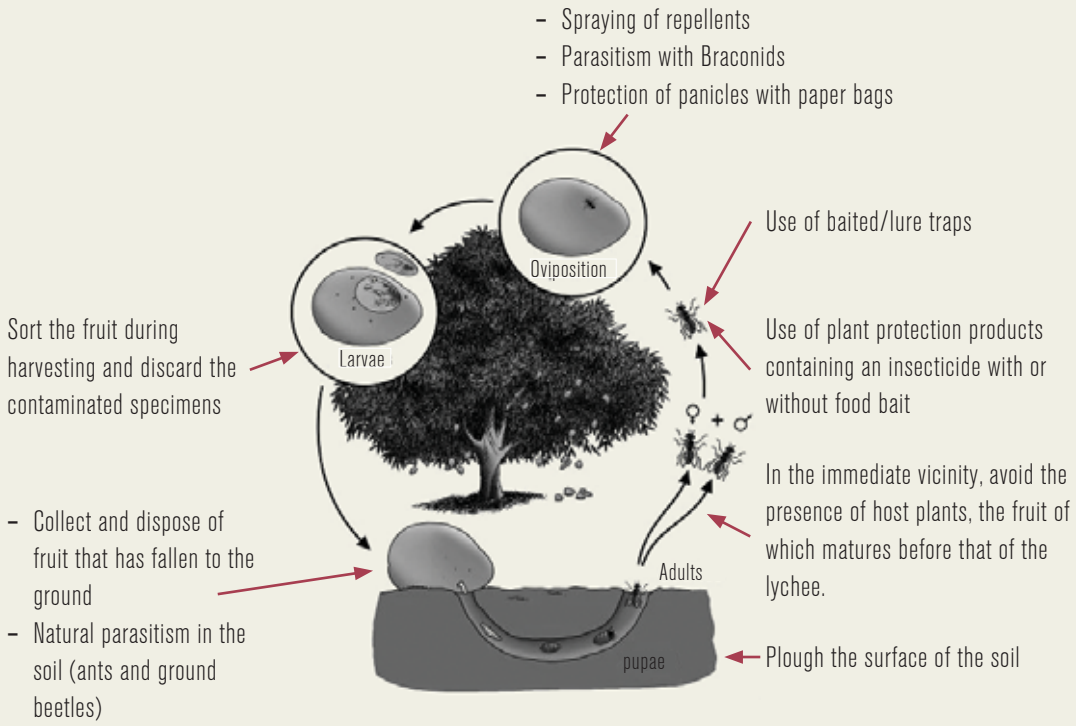
On preparing the soil
- Eliminate the host plants and create natural shelters for beneficial insects around the orchard.

In the nursery
- Young plants in the nursery are vulnerable to aphid attack. Host plants should be removed from the nursery environment.
- Application of a selective insecticide at the first sign of attack upon young plants.
- Protect the young plants by covering with insect-repellent nets.

In the orchard
- Application of a selective insecticide at the first sign of attack during periods of plant growth.
- Some plants are reputed to keep aphids at bay (in particular: Indian carnations, etc.); they can be planted close to the crops.
- Install yellow traps to capture the winged insects.
- Introduce ant control.

FRUIT FLIES - *CERATITIS CAPITATA* AND *CERATITIS ROSA*

Position of control methods on the life cycle of the pest



The above diagram outlines the life cycle of fruit flies in mango trees (identical for lychees).
Like all flies, they undergo complete metamorphosis. The female lays its eggs in clusters under the skin of almost ripe fruit. Proteins are needed during the laying period. The eggs hatch 2 to 5 days later. After spending between 9 and 15 days inside the fruit, the asticots (third larval stage) emerge and, once on the ground, transform into pupae before finally becoming adult flies.

Position of control methods on the life cycle of the plant

In the orchard

From the first cluster formations

- Baited/Lure traps are scattered throughout the cultivation plot to reduce somewhat the adult fly population.
- Insecticide treatments are applied as soon as the threshold is reached (to be determined locally).
- Panicles are protected with paper bags after the fruit has physiologically fallen.

From the first harvests

- Collect and destroy all of the damaged fruit by burying to a depth of 60-90 cm in the soil or by burning.

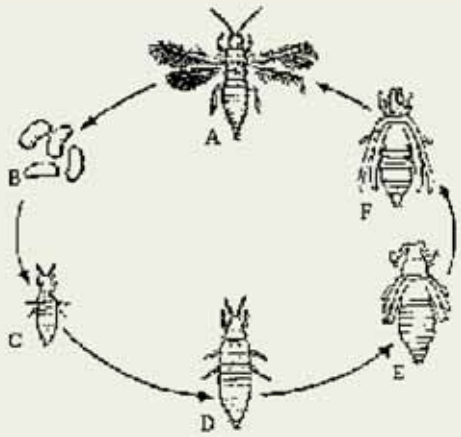
After the final harvests

- Add lime to the soil when burying the fruit in order to kill the emerging larvae.
- Plough the surface of the soil to collect the pupae lying on the surface and expose them to predators, parasites and sunlight.

THRIPS

Position of control methods on the life cycle of the pest

Avoid the repeated use of insecticides with a broad spectrum of activity, which are harmful to beneficial insects.



To ensure control at all stages

- Avoid the presence of host plants such as avocado, citrus, cashew nut, cacao, palm and guava trees in the immediate vicinity
- Pruning enhances the penetration of light
- The installation of a wind-break can reduce the population of thrips, which are disseminated by the wind.
- Application of insecticides, as required.
- Natural predators: predator mites, predator thrips, predator bugs, *Entomophthora*.

Position of control methods on the life cycle of the plant

In the orchard

Before planting fruit trees

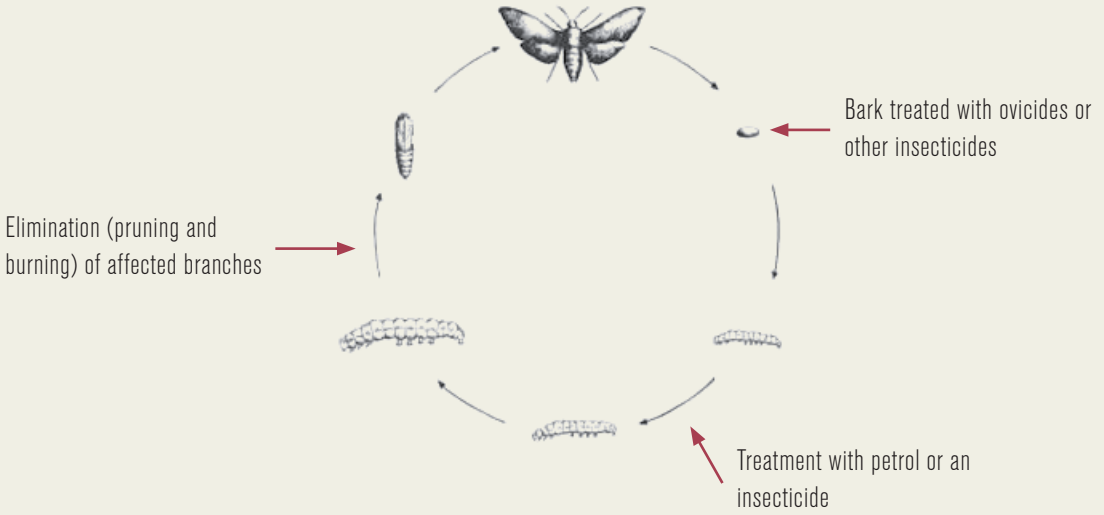
- Since thrips are wind-borne, the installation of a wind-break can reduce their population.
- Avoid the presence of host plants (avocado, citrus, cashew nut, cacao, palm and guava trees, etc.) in the immediate vicinity.

At all stages

- Larvae and adult thrips are sensitive to light, the penetration of which is promoted by pruning.
- Spray insecticides that are non-toxic to natural predators if necessary.

CHLUMETIA (*SALAGENA*) *TRANSVERSA*

Position of control methods on the life cycle of the pest



Position of control methods on the life cycle of the plant

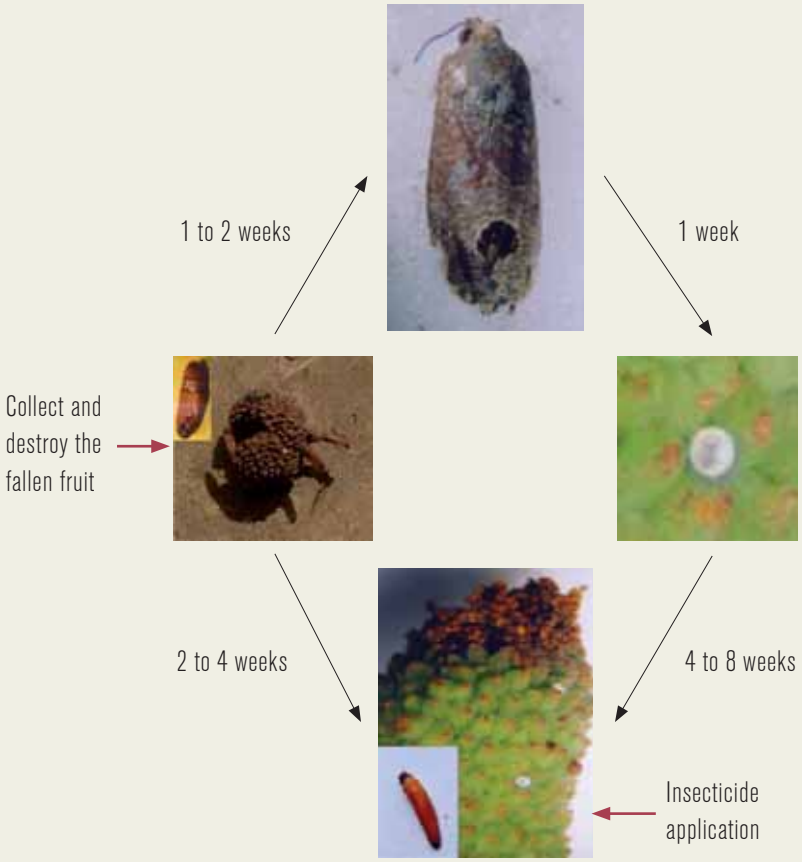
In the orchard

All year round, but mainly on trees that have lost their vigour

- The monitoring of young plants facilitates the detection of initial attacks. These generally warrant only one insecticide application and only in the event of significant infestation.
- A healthy, properly maintained orchard is seldom attacked by these lepidoptera. The collection of prunings is the most effective method of preventing infection.
- When galleries are detected, they are blocked with cotton wool saturated with petrol. This will eradicate the larva before it can cause any damage. Girdled branches are cut and burned.
- Control via the application of PPPs is very difficult given the position of the caterpillars.

CRYPTOPHLEBIA SP.

Position of control methods on the life cycle of the pest



Position of control methods on the life cycle of the plant

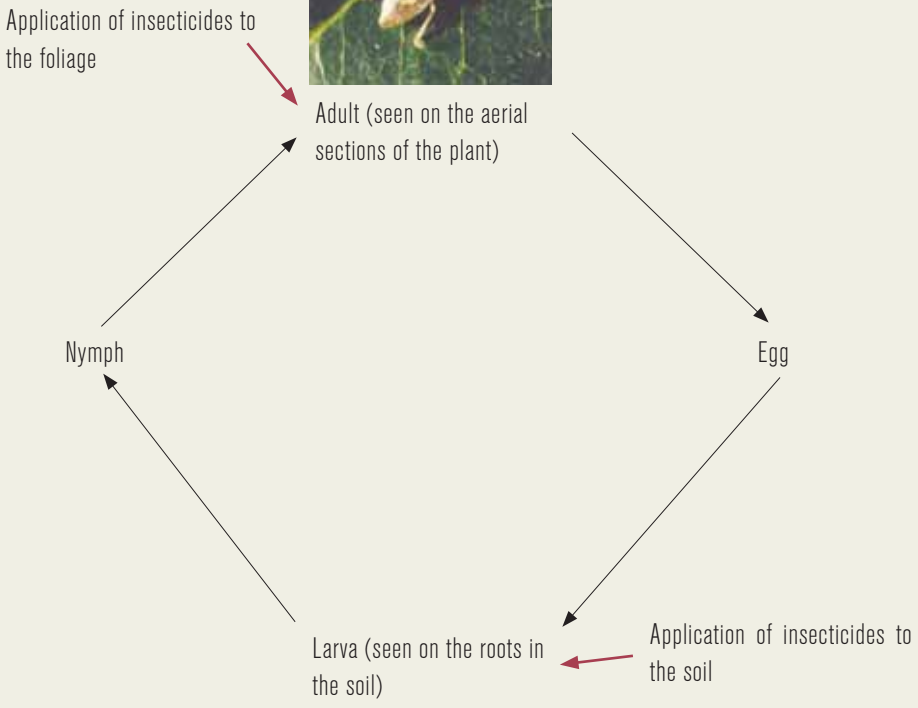
In the orchard

As soon as the fruit reaches the size of a small pea, continuing through to harvesting.

- The fallen fruit is collected and burned.
- Insecticide application when 5% of the panicles bear fruit formed up to 20 days prior to harvesting.
- The panicles can be protected with paper bags.

WEEVIL - *CRATOPUS ANGUSTATUS*

Position of control methods on the life cycle of the pest



Position of control methods on the life cycle of the plant

In the orchard

Avoid mixing crops with other host plants.

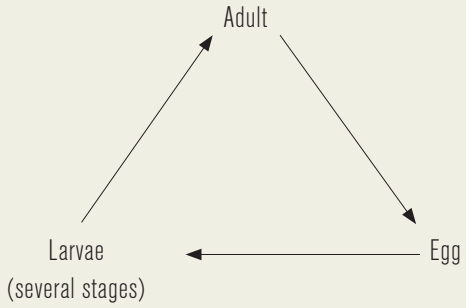
From the start of flowering through to harvesting.

- Use of insecticides.

MITE – *ACERIA LITCHII*

Position of control methods on the life cycle of the pest

The mite is carried and disseminated in the orchards by the wind, birds and other animals.
Close inspection underneath the leaves can highlight the early stages of infestation.
In the case of repeated application, it is advisable to alternate with active substances having a different mode of action in order to limit the onset of resistance.
The control measures must be preventive because it is difficult to eradicate the mite once it is present.
Marcottage is recommended on healthy, intact trees in nurseries.



To ensure control at all stages

- Promote and diffuse natural enemies such as predator spiders.
- Apply specific acaricides in order to control the larvae, nymphs and adults (some are also ovicides).
- Remove and immediately destroy the infested parts in order to prevent a population rise in orchards.

Position of control methods on the life cycle of the plant

In the orchard

- Mite-infested parts must be removed and burned.
- The mite population can be limited by applying acaricides when mites migrate from old to new leaves.
- This pest has numerous predators, especially among the *Phytoseidae*.

Anthracnose *(Colletotricum gleosporioides)* and other agents responsible for rot after harvesting

The pathogens responsible for rot include *Alternaria* sp., *Aspergillus* sp., *Botryodiplodia* sp., *Rhizopus* sp., *Penicillium* sp., *Colletotrichum* sp. and various yeasts.

Key factors in the control strategy:

- Use resistant varieties.
- Avoid conditions conducive to growth.
- Rot can be controlled by reducing the physical waste of the fruit, ensuring rapid chilling and by maintaining optimal temperature and relative humidity during the sale of lychees.
- The use of an atmosphere enriched with 10-15% CO2 and biological management are additional rot control methods for consideration.

The following table lists the degree of efficacy of various protective measures, the sources of the inoculum and conditions conducive to the emergence and development of fungi.

Table listing the main fungi responsible for rot after harvesting: sources and dissemination of the inoculum, conditions conducive to the infections and development, and the efficacy of the protective measures.

Fungus	Source of inoculum			Dissemination		Latent infection			Development		Efficacy of the protective measures			
											in the orchard			after harvesting
	leaves	flowers, branches	debris, soil, fruit	precipitation (rainfall)	wind	external	internal	on harvesting	< 24°C	< 24°C	preventive	plant protection products	careful harvesting	cold, optimal relative humidity, CO2-enriched atmosphere
Alternaria	++	++	++	++	+++	+++	+	+	++	+	+++	+	++	?
Colletotrichum	++	++	+	+++		+++	-	+	+	+++	+++	+	++	?
Aspergillus	-	-	+++	-	+++	-	-	+++	++	++	++	-	+++	?
Botryodiplodia	?	?	?	?	?	?	?	?	?	?	?	?	?	?

-: not applicable; + irrelevant; ++: relatively important; +++ very important; ? connection unknown

Position of control methods on the life cycle of the plant

In the Nursery

- Only insensitive varieties must be selected in regions characterised by a dry season of less than two to four months before flowering.

In the orchard

On planting

- Select young plants from nurseries where the plants have been protected against disease.
- Leave an adequate space between the plants to promote the circulation of air.
- Avoid the presence of host plants such as citrus, banana, papaya, avocado, coffee and cashew nut trees in the immediate vicinity.

Procedures to be carried out regularly

- Good ventilation in the orchard plays a vital role in combating anthracnose. Consequently, dead leaves and branches must be pruned regularly. A good nutritional balance is also very important, especially as regards nitrogen.
- Limit the height of the lychee plants by pruning in order to ensure that the plant protection products have an effect on all the foliage.
- Regularly collect and burn dead or necrosed organs strewn on the ground (residues of inflorescences, dried branches and dead leaves, including the leaves of young plants, etc.).

Before flowering

- Flowering is a highly sensitive phase. It is therefore essential to prune all the (necrosed) areas infected by anthracnose

At the start of fruit formation

- Cleaning the orchard: collect all of the fallen fruit to prevent it from rotting in the soil.

After harvesting

- Handle the fruit carefully during and after harvesting: the slightest lesion inflicted on the skin during harvesting, packaging or transport may trigger the recurrence of latent infections or even a new infection due to the spores present on the fruit during the rainy season.
- The storage of lychees at low temperature and in a controlled atmosphere helps to cut rot-induced losses after harvesting.
- Carry out effective pruning after harvesting to ensure that the orchard soil receives sunlight.

Algae - *Cephaleuros* **spp.**

Key factors in the control strategy:

- Some cultivars are highly sensitive (such as “Souey Tung” and “Haak Yip”).
- This alga can be controlled by spraying with fungicides.

Bats and birds

Key factors in the control strategy:

- Ripe lychee is a favourite foodstuff of several species of bird, some bats and even squirrels. Birds are so fond of the lychee that they even consume unripe (green) fruit.
- The control method most widely used involves covering the trees with a net. However, the best solution is bagging fruit clusters – a method used for a number of other parasites.
- The nocturnal use of ultrasound generators combined with light projectors also ensures effective bat control.

Browning after harvesting

Key factors in the control strategy:

- Control methods for consideration include maintaining the humidity level in the fruit shell, blocking the enzymatic systems responsible for browning (using an inhibitor) and limiting fungal or bacterial attacks.
- Fumigating the fruit with SO_2 (sulphur dioxide either used in its gaseous state or obtained by burning flowers of sulphur) a few hours after harvesting is the most popular method for maritime transport. However, some alarming information about MRL exceeding for sulphite (as a food additive) on lychee fruits exported to Europe have been reported. It is recommended to harmonise the lychee post harvest fumigation with sulphur as best as possible which should lead to acceptable residues of SO2, ie below the MRL of 10 mg/kg in edible parts of lychees.
- As an alternative SO_2 lychee treatment is sometimes followed by saturation in an acid bath to restore the red colour of the fruit following discolouration with sulphur. Commercially active fruit are obtained in this way with less SO2 analysed in the pulp.
- Packaging in polymer films and the control of a modified atmosphere (3-5% of O_2 and 3-5% of CO_2) reduces water loss and the intensity of the browning. With this kind of MAP (Modified Atmosphere Packaging) no problems regarding the SO2 MRLs are expectable, but they are less effective when maritime transport is considered.
- Storage at a low temperature (5°C) with a relative humidity of 90 to 95% can also delay the browning of lychees. Conversely, an excessively low temperature (1°C) can cause browning of the pericarp in some cultivars. But these low temperatures of 1-2°C are absolutely necessary during the 25 days of a maritime transport to guarantee fresh fruits.

2.3. The interest in and use of beneficial insects

Natural enemies such as certain ladybirds, chrysops and hoverfly larvae act as beneficial insects, preventing and limiting the explosion of certain pest populations. Insecticides with a broad spectrum of activity should, therefore, be avoided whenever possible.
Preference should be given to selective actives substances (when available) to preserve the beneficial insects.

Seychelles scale.
Biological control: Seychelles Scales have numerous natural, effective enemies: hymenoptera parasites, ladybirds, etc. but are protected from these enemies by ants. Biological control against Seychelles scale involves preventing ants from accessing the trees. This can be carried out by sprinkling insecticidal power around the base of the tree or even coating the trunks with white paint.

List of some of the natural enemies of the Seychelles Scale observed in the lychee orchard:

Parasitoids:

- *Cryptochetum grandicorne*, attacks the nymphs in Japan, India, Pakistan and Israel
- *Cryptochetum monophlebi*, attacks the nymphs in Madagascar and Mauritius (introduced)
- *Euryischia indica*, attacks nymphs and adults in India

Predators:

- *Rodolia cardinalis*, attacks the eggs, nymphs and adults in numerous regions (Australia (introduced), Japan, American Samoa, Cook Islands, Fiji, French Polynesia, Guam, New Caledonia, Vanuatu, Seychelles)
- *Rodolia chermisinia*, attacks the eggs in Mauritius and the Reunion Islands
- *Rodolia limbatus*, attacks the eggs in Japan

Aphids

Natural enemies such as certain ladybirds, chrysops and hoverfly larvae feed on aphids. Micro-hymenopterae lay their eggs in aphid larvae. The wasp larva develops inside a live aphid and finally emerges leaving an empty, golden or brown "shell" behind it. Moulds can also infect aphids, substantially reducing their population.

Thrips

Most conventional insecticides seem to stimulate the thrips population, probably by eliminating the predators that would otherwise control them. Insecticides with a broad spectrum of activity should be avoided as much as possible. When available, selective active substances should preferably be used to preserve natural enemies, such as *Orius* spp.

3. Monitoring plant protection practice and intervention thresholds

Essential measures for disease and pest control constitute good agricultural practices.
When a pest or disease is identified, Plant Protection Products should ideally be used only as a last resort. Preference should initially be given to preventive control measures. The majority of plant protection products are not selective and are also harmful to beneficial pests. Regular monitoring is, therefore, needed in order to prevent any infestation or infection warranting the spraying of the entire orchard.

It is suggested that orchards be inspected at least twice a week to check for the appearance of pests and diseases as well as beneficial insects. If possible, localised application should be selected and a complete spraying procedure initiated only where necessary.

Example of the grid outlining the controls for diseases and pests affecting the lychee:

Disease or pest treated	When?	Frequency	Where?	How?	Sampling
Fruit flies	From when the fruit reaches maturity	Weekly	Covered-over traps	Traps (pheromones or food bait)	
Thrips	In the Nursery In the orchard	Monthly	– Inflorescences – Lower surface of the leaves	– Tap the tip of the branches over a white sheet – Yellow sticky traps	- 10 marked trees per block (1 hectare)
Anthracnose	Before and after harvesting	Weekly	Flowers and fruits		- 10 marked trees per block (1 hectare)
Erinose	Summer and autumn	Weekly	Leaves	Visual inspection	- 20 marked trees per block (1 hectare)

Intervention thresholds:

As a general rule, the intervention thresholds are determined according to the species of pest present and local conditions, which vary from one country to the next and even from one production site to the next. No intervention thresholds have been drawn up for lychee to date.
Close inspection is, however, desirable, because changes in pest populations must be monitored. It is extremely useful to know and analyse fluctuations in the population density and intervene in the event of a sudden rise.
The controls should be carried more frequently when conditions conducive to the development of pests/onset of diseases prevail.
Each control visit must be carried out by the same operator, who will complete an inspection form on each occasion.
It is particularly important to monitor changes in pest populations and disease incidence during the floral induction period, three or four weeks after flowering, and every three weeks, thereafter.
An effective control must be based on the specific characteristics of the insects and diseases concerned.

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 is also shown. Any change in one or more elements of these GAPs (increase in the doses, frequency of application and number of applications, last application before harvest not respecting the recommended pre-harvest interval) can result in residues in excess of the MRL in force. At this stage, however, it is worth noting that no tests have been carried out in ACP production environments to check compliance of MRLs with the GAPs indicated. These GAPs does not represent a treatment calendar to be applied as such. In practice, the frequency of treatments must take account locally of the severity of attacks and the real risks of damage.
The list of active substances proposed has been drawn up taking into account the products used by ACP producers and the products registered in ACP countries or elsewhere.
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 volume of mixed spray solution must be adapted to the volume of trees and organs to be treated (trunk, inflorescences, leaves, fruits).

Seychelles scale (*Icerya seychellarum*)

Strategy: Apply at the end of afternoon to avoid burning on leaves. As for other scales, to control properly the population, it is very important to do the winter treatments with oils at high volumes (asphyxial action on first stage of larvae). The optimal period to spray is at the beginning of dispersion of the larvae L1 which are the only stage sensible to treatments since not protected by the shield.

Active substance	Recommended GAP				Proposed application period						
	Dose g/ha	Number of applications	Interval between applications (days)	Pre-harvest interval (days)	Nursery	Flowering	Fruit setting to fruit enlargement	Harvest	Vegetative growth	Dormancy of buds	Post harvest
White oils	1.5 l	/	/	3		■	■		■		
Horticultural oils *	Solution at 1-2 %	/	42	2			■		■		

/ elements of the recommended GAP not available

*Note on horticultural oil sprays :

They are concentrated and must be mixed with water. Before spraying on a large scale, it is advised to test the concentration on a few trees as young leaves may be very sensitive to horticultural oil sprays. Avoid spraying at flowering and vegetative flush.

Spray 2% solution against insects and mites. Apply successive sprays at least 6 weeks apart. Following the mineral oil spray, use a high pressure water jet treatment to dislodge dead scales from trees. It is important to remove the dead scales remaining on the plant because this will ensure protection against newly hatched scales. To dislodge living scales is to use a forceful jet of water to 'power wash' them from barks.

Fruit flies – *Ceratitis capitata* (*Ceratitis rosa*)

Strategy: When the survey indicates that the pressure is high, apply spot treatments using a food attractant and spraying where sections of the trees with no fruits. Apply every 10 days spraying 1m2 per tree on one tree on two. Count flies in the sexual traps every week. Start off the treatment when there are 20 flies caught per day in the trap (the threshold should be adapted locally).Treat also windbreaks as lures.

Active substance	Recommended GAP				Proposed application period						
	Dose g/ha	Number of applications	Interval between applications (days)	Pre-harvest interval (days)	Nursery	Flowering	Fruit setting to fruit enlargement	Harvest	Vegetative growth	Dormancy of buds	Post harvest
Protein hydrolisate + malathion	/	/	/	*			■	■			
Protein hydrolisate + deltamethrin	/	/	/	*			■	■			
Protein hydrolisate + spinosad	/	/	/	*			■	■			
Parapheromone + fipronil	Sexual traps attracting and killing males						■	■			
Protein hydrolisate + malathion	Used in traps						■	■			

/ elements of the recommended GAP not available * normally no risk of residues , so no PHI, if spray don't touch the fruits

Thrips

Strategy: Treatments will be against nymphs and adults.

Active substance	Recommended GAP				Proposed application period						
	Dose g/ha	Number of applications	Interval between applications (days)	Pre-harvest interval (days)	Nursery	Flowering	Fruit setting to fruit enlargement	Harvest	Vegetative growth	Dormancy of buds	Post harvest
Pyrethrins	/	/	/	/					■		

/ elements of the recommended GAP not available

- Plants that have a natural repellent to thrips are citronella, garlic and pyrethrum.
- Pyrethrum, extracted from *Chrysanthemum cinerariaefolium* is productive mainly above an altitude of 1600m.
- Soap spray will kill thrips. Treatment needs to be repeated twice a week.

Salagena sp. *Chlumetia transversa*											
Strategy: The collection of prunings is the most effective method of preventing infection. When galleries are detected, they are blocked with cotton wool saturated with petrol. This will eradicate the larva before it can cause any damage. Girdled branches are cut and burned. Contro with PPP is very difficult since the insect is hidden but could be efficient.											
Active substance	Recommended GAP				Proposed application period						
	Dose g/ha	Number of applications	Interval between applications (days)	Pre-harvest interval (days)	Nursery	Flowering	Fruit setting to fruit enlargement	Harvest	Vegetative growth	Dormancy of buds	Post harvest
Carbaryl	Dilution 0,2 %	2	14	/							

Llychee moth - *Crytophloebia peltastica*											
Strategy: The fallen fruits are collected and burned. In areas of high pressure one should start the treatments when fruits have a size of small peas. Apply carbaryl or azinphos-methyl, when 5% of the panicles bear fruit formed. Then, after physiological shedding of fruits, apply alternately carbaryl and dimethoate up to 20 days prior to harvesting.											
Active substance	Recommended GAP				Proposed application period						
	Dose g/ha	Number of applications	Interval between applications (days)	Pre-harvest interval (days)	Nursery	Flowering	Fruit setting to fruit enlargement	Harvest	Vegetative growth	Dormancy of buds	Post harvest
Carbaryl	150	/	/	20							
Dimethoate	30	/	/	20							
Azinphos-methyl	45	/	/	20							

/ elements of the recommended GAP not available

Weevil - *Cratopus angustatus*

Strategy: Important damage could occur, on inflorescences and fruit-bearing stems in cool area. In these area , one should treat preventively at the appearance of inflorescences.

Active substance	Recommended GAP				Proposed application period						
	Dose g/ha	Number of applications	Interval between applications (days)	Pre-harvest interval (days)	Nursery	Flowering	Fruit setting to fruit enlargement	Harvest	Vegetative growth	Dormancy of buds	Post harvest
Carbofuran	600	/	/	/		Soil application					
Methomyl	350	/	/	/							

/ elements of the recommended GAP not available

Mites - *Aceria litchii*

Strategy: If heavy attacks occur, apply the first treatment just before the vegetative flush. If the mites are observed at flowering, apply before development of the panicle and then apply two time before floral buds opening. Monitoring should be done regularly in order to detect appearance of symptoms in summer and autumn.
Sulphur is effective but should be applied early in the morning or late in the evening when the temperature is below 28°C to avoid phytoxicity.
If the pressure is high, it is better to use a specific miticide.

Active substance	Recommended GAP				Proposed application period						
	Dose g/ha	Number of applications	Interval between applications (days)	Pre-harvest interval (days)	Nursery	Flowering	Fruit setting to fruit enlargement	Harvest	Vegetative growth	Dormancy of buds	Post harvest
Sulphur	7,500	/	/	14							
Dicofol	500	/	/	15							

/ elements of the recommended GAP not available

- In Australia, three applications of dimethoate or sulphur every two or three weeks, at the vegetative flush, give a good control of this pest.
- In China dichlorvos, dimethoate, dicofol, chlorpyriphos, omethoate and isocarbofos are recommended.

Anthracnose - *Colletotrichum gloeosporioides*												
Strategy: Apply a fungicide every 14 days taking care to alternate chemical families. Repeat the treatment after a rain.												
Active substance	Recommended GAP				Proposed application period							
	Dose g/ha	Number of applications	Interval between applications (days)	Pre-harvest interval (days)	Nursery	Flowering	Fruit setting to fruit enlargement	Harvest	Vegetative growth	Dormancy of buds	Post harvest
Mancozeb	1,600	3 to 4	14	14							
Copper hydroxide	2,500			2							
Thiophanate-methyl	1,200			3							

/ elements of the recommended GAP not available

Algae - *Cephaleuros* sp.											
Strategy: It can be controled with copper applications on the trunk at the beginning and the end of the rainy season.											
Active substance	Recommended GAP				Proposed application period						
	Dose g/ha	Number of applications	Interval between applications (days)	Pre-harvest interval (days)	Nursery	Flowering	Fruit setting to fruit enlargement	Harvest	Vegetative growth	Dormancy of buds	Post harvest
Copper hydroxide	250 / 100 litres of water	3 to 4	30	2							

/ elements of the recommended GAP not available

5. Existing registrations

There are no known registration of PPP specific to lychee in ACP countries.

6. European regulations and pesticide residues

Status of the active substances in Directive 91/414 and European MRLs and Codex MLRs in june 2011
Caution: The information contained in this table is subject to change by future directives of the Commission of the European Communities.

MRL for the lychee			
Active substance	European regulation		LMR Codex mg/kg
	Status DIR 91/414	European MRL (in mg/kg)	
Azinphos-methyl	**Withdrawn**	0.05**	/
Carbaryl	**Withdrawn**	0.05**	/
Carbofuran	**Withdrawn**	0.02**	/
Copper	**Annex 1**	20	/
Deltamethrin	**Annex 1**	0.05**	/
Dicofol	**Withdrawn**	0.02**	/
Dimethoate	**Annex 1**	0.02**	/
White oils	**Withdrawn**	0.01*	/
Malathion	**Annex 1**	0.02**	/
Mancozeb	**Annex 1**	0.05**	/
Methomyl	**Annex 1**	0.02**	/
Pyrethrin	**Annex 1**	1	/
Sulphur	**Annex 1**	n.a.	/
Spinosad	**Annex 1**	0.02**	/
Thiophanate-methyl	**Annex 1**	0.1**	/

* = default MRL
** = LOQ value
/ = MRL no specified

Export to the EU requires compliance with the EU MRL (Maximum Residue Level). At treatment the sulphur is burned and forms with oxygen sulphur dioxide. The post harvest treatment with sulphur on lychees is categorised as a "food additive" and the corresponding Directive N° 95/2/EC can be found at the SANCO web site under the following link:
http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1995L0002:20060815:EN:PDF.
This Directive has been amended by the Directive 2006/52/EC also available at SANCO web site under the link:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:204:0010:0022:EN:PDF
The EU MRL for SO2 on lychees is listed in this Directive and has been set at 10 mg/kg in the edible part of the fruit.

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. Directive 91/414/EEC provides a comprehensive list (Annex I) of active substances that can be incorporated in plant protection products. This Directive and its amendments are available on: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31991L0414:EN:NOT
The status of active substances can be checked on the following web site: http://ec.europa.eu/sanco_pesticides/public/index.cfm.
Regulation (EC) No 1107/2009 concerning the placing on the market of plant protection products replaces Directive 91/414/EEC from June 14, 2011.
http://europa.eu/legislation_summaries/food_safety/plant_health_checks/sa0016_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.htmand 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
ACP countries don't have set their own MRLs, therefore they usually admit Codex LMRs for foodstuffs marketed in their country.
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.

Annexes

1. References and useful documents

ANONYMOUS (1985). *An album of Guangdong litchi varieties in full colour*. Guangdong Province Scientific Technology Commission.

APPERT JEAN, DEUSE J. (1982) *Les ravageurs des cultures vivrières et maraîchères sous les tropiques*, Techniques agricoles et productions tropicales. 420 p.

BAILLY R. (1980) *Guide pratique de défense des cultures*. Reconnaissance des ennemis, notions de protection des cultures. ACTA, 418 p.

BOVEY R. (1979) *La défense des plantes cultivées*. Traité pratique de phytopathologie et de zoologie agricole. Ed. Payot Lausanne, 864 p.

CTA – PAN (1993) *Pesticides et agriculture tropicale*, dangers et alternatives. 281 p.

DEUSE J. et LAVABRE E.M. (1979) *Le désherbage des cultures sous les tropiques*, Techniques agricoles et productions tropicales. 312 p.

FABRE F., RYCKEWAERT P., DUYCK P.F., CHIROLEU F. and DUILICI S. (2003) *Comparison of the efficacy of different food attractants and their concentration for melon fly*. J. Econ. Entomol. 96 (1): 231-238

FRÖHLICH G. & RODEWALD W. (1970) *Pests and diseases of tropical crops and their control*. Pergamon press, 342 p.

GROFF GW (1921). *The lychee and longan.* Orange Judd Company, New York.

HILL, D. (1975). *Agricultural insect pests of the tropics and their control*. Cambridge Univ. Press, Cambridge. 516 p.

JONES & JONES (1966) *Pests of Field crops*. Arnold, 386 p.

MENZEL, C.M. (1983). *The control of floral initiation in lychee: a review*. Scientia Horticulturae, 21: 201-215.

MENZEL CM (1984). *The pattern and control of reproductive growth in lychee: a review*. Scientia Horticulturae, 22: 333-345.

MENZEL CM, SIMPSON DR (1986). *Description and performance of major lychee cultivars in subtropical Queensland*. Queensland Agricultural Journal, 112: 125-136.

MENZEL CM, SIMPSON DR (1987). *Lychee nutrition: a review*. Scientia Horticulturae, 31: 195-224.

MENZEL CM ET AL. (1988). *The lychee in Australia*. Queensland Agricultural Journal, 114: 19-27.

RAEMAECKERS ROMAIN H. (2001) *Agriculture en Afrique tropicale*, DGCI, 1634 p.

2. Useful websites

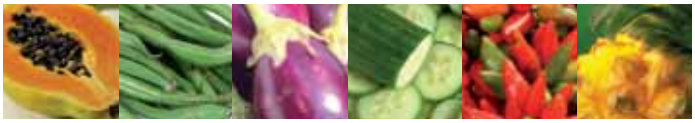
http://www.uga.edu/vegetable/aphids.html
http://plant-disease.ippc.orst.edu/ (Plant disease control – Oregon state university)
http://www.ceris.purdue.edu/napis/pests/index.html
http://www.inra.fr/Internet/Produits/HYPPZ/ravageur.htm
http://www.hort.uconn.edu/ipm/general/misc/contents.htm
http://perso.wanadoo.fr/claude.declert/
http://res2.agr.ca/stjean/publication/web/aphidinae8_f.htm
http://www.infoagro.com/frutas/frutas_tropicales/litchi.htm
http://www.ctht.org/litchi.php
http://www.rbgsyd.nsw.gov.au/science/hot_science_topics/Soilborne_plant_diseases/Vietnam_template3/Disease_Complexes
http://www.fao.org/docrep/005/ac681e/ac681e00.htm#Contents
http://litchidemadagascar.com/litchi_action_plan.php
http://www.hort.purdue.edu/newcrop/morton/lychee.html
http://www.capetrib.com.au/lychee.htm
http://www.crfg.org/pubs/ff/lychee.html
http://www.patentstorm.us/patents/6093433-description.html
http://edis.ifas.ufl.edu/MG051
http://www.lycheesonline.com/

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

Printed on FSC-certified paper with
environmentally friendly solvent-free inks.