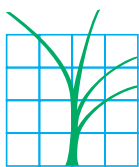




Pink Lady[®]: key points



Ctifi



Éditions Centre technique interprofessionnel
des fruits et légumes

Pink Lady[®]: key points



Ctifl



Pink Lady®: key points

ISSN: 978 287 911 277-0

JUNE 2008

Any representation or reproduction, in part or in full, without prior consent of the author or rights holders or other successors, is expressly prohibited (law of 11 March 1957, paragraph 1 of article 40). Such representation or reproduction, by any means whatsoever, constitutes an infringement punishable under articles 425 et seq. of the French penal code. The law of 11 March 1957, in the provisions of paragraphs 2 and 3 of article 41, only authorises, on the one hand, those copies or reproductions for strictly private information purposes of the person making the copy and prohibits any collective usage and, on the other hand, analyses or short citations for the purpose of examples and illustrations.

Pink Lady[®]: key points

Coordination and drafting

Vincent Mathieu, Ctifl
Sandrine Codarin, Ctifl
Vincent Mathieu-Hurtiger, Ctifl
Claude Tronel, Ctifl/CEHM
Mélanie Bordet, APLE

in collaboration with

Frédéric Aubert, BLUE WHALE
Claude Coureau, Ctifl/La Morinière
Xavier Crété, CEHM
Jean-Philippe Dupin, Vergers d'Anjou
Georges Fandos, COFRUID'OC
Gérard Ferré, CEHM
Bruno Hucbourg, GRCETA
Christophe Mouiren, GRCETA
Laurent Roche, Ctifl
Patrick Soing, Ctifl
Pierre Vaysse, Ctifl
Pascale Westercamp, Ctifl/Cefel
Franziska Zavagli, Ctifl

and support of Star Fruits[®], Christophe Roduit, Bertrand Rehlinger
Vincent Gaillet, Fruilar, Piero Turrone (Apofruit), Maurizio Sgobbi
and Katia Lupato (Cico), Angelo Zanella (Laimburg)
Jenny Jobling (University of Sydney)

CONTENTS

Foreword 8

Marketability 10

Coloration 11
Shape 12
Size 12
Taste quality 13
Zero defect target 14
Storage capacity 15

Planting 16

Key points 17
Planting of the orchard 18
Other important factors 21
To be followed... 23

Tree management 24

Tree management: development phase 26
Key points in the tree development phase 26
Development of young trees 27
Tree management: fruiting phase 29
Key points in the fruiting phase 29
Winter pruning 30
Summer pruning 32
Food for thought 33
Testimonial 35

Crop load management 36

Key points of the fruit load management 37
Assess the orchard's production potential in its soil-climate zone 40
Production objectives 42
Chemical thinning 44
Additional hand thinning: profitable operations 45
Upcoming perspectives and new products 46
Testimonial 47

Nutrition - Soil management 48

Key points	49
Irrigation	50
Nutrition	51
Monitoring and maintaining soil structure	52
Food for thought	54
Testimonial	55

Harvest 56

Key points	57
Harvest organisational set up	58
Harvest precautions	59
When and how to start harvest?	61
Harvest period	63
Objectives and implementation of maturity network	63
Perspectives	64
Testimonial	65

Storage 66

Key points for storage without problems	68
Improve storage management	69
Few tips to follow...	73
Testimonial	75

For further information...

Useful addresses	78
------------------	----



“So much more than an apple!”



Right from the beginning, Pink Lady® has set very high standards. This quality assurance is the key to the success of our holistic approach to Pink Lady® apples. This approach meets the expectations of consumers in terms of taste while taking into account the financial considerations of growers and represents the requirements of the entire network.

The variety's unique and exceptional quality factors are determined in the orchard and packing-house. The great strength of our organisation is having brought together, even if in an informal way, the skills required to rise up to this challenge. Right from the beginning of this adventure, technicians, research scientists, technical institutes, experimental centres, pioneer and motivated growers have all pooled together their knowledge and experience at a European and even world level with a view to break new ground. This document is the fruit of over ten years of observation and field work. The members of Pink Lady® Europe are grateful to all those who have contributed to perfecting the quality of our product through their competence and open mindedness.

In addition to the annual technical meetings, we aim to make the most up to date knowledge available to all players involved in the development of the Pink Lady® product. We have also aimed to develop a resource tool specific to the Cripps Pink_{cov} variety and its derivatives, which is designed to be more than just a user guide and comes to supplement the work of the orchard technicians.

This technical manual is divided into seven chapters. After an introduction to the fundamentals of the Pink Lady® product, the manual focuses on six key stages: planting, tree management, crop load management, nutrition and soil management, harvest, and storage.

Each stage includes information on:

- specific characteristics of the variety influencing the approach,
- important key points and how to avoid pitfalls,
- furthering acquired knowledge,
- paving the way to the future.

At the end of a chapter, a testimonial from a grower or technician applies the information to the practical application in the field.

I would like to thank all the people involved in the drafting of this manual and people who contributed to enriching the manual by drawing from their observations or field work. I am also thankful to Ctifl who played an active role in coordinating this project with the technical team of Pink Lady® Europe and Star Fruit®, and for drafting this document.

Knowledge is never set. I hope that each person finds the necessary information to further their development. I also hope that they will contribute to further deepening of this knowledge in line with the Pink Lady® spirit.



Didier Crabos,
Chairman of the Pink Lady® Europe Association



Chapter 1

Marketability

Pink Lady® owes its success not only to the marketing approach adopted but also to the inherent qualities of the apple: attractive, crisp, juicy and fragrant. Cripps Pink_{cov} has also a rather unique colour making it easy for people to identify the fruit.

All of these characteristics are mentioned and catalogued in a specifications guide. Complying with these specifications assures a uniform quality of Pink Lady® apples which are ranked as a premium product in the market. The entire network is thus organised with a view to attain this quality objective and ensure customer satisfaction.

Right from the planting of the orchard, all actions and choices of the tree grower will determine the development of the variety's exceptional potential. This target for excellence must always be the underlying aim in orchard management: Pink Lady®, so much more than an apple!

Even though Cripps Pink_{cov} is a variety displaying an outstanding agronomical performance, obtaining a fruit that is in line with the specifications is not always an easy task. A sound knowledge of the variety and of the clearly defined specifications is essential.



Crop –
bi-coloured
apple



■ Coloration

Cripps Pink_{cov} is a bi-coloured apple, whose main colour ranges from light pink to red. The colour is blushed and bright, and covers a quarter to three quarters of the fruit's surface.

When Pink Lady® apples are packaged, only the fruit that have at least a **40 % coloured surface on the same side with a “bold pink to red” intensity are selected**. They correspond to the R3 minimum level of the colour code Ctifl – Association Pink Lady® Europe – Star Fruit®.

The orchard orientation, tree management method (tree shape and exposure to sunlight), as well as crop load management all impact on whether the fruit meet these colour requirements.

Despite all the care taken, in some regions and during some years, the lack of cold mornings and/or lack of sunshine and cool days during the harvest season can prevent the fruit from obtaining the desired colour.

The new clone Rosy Glow_{cov} has the advantage of obtaining its colour sooner than Cripps Pink_{cov}. It is thus especially suited to these regions where weather conditions during harvest season are not always ideal.

The background colour of the fruit ranges from green to yellow-green. It gradually turns yellow at the end of the storage period. A rather distinct yellow of the fruit at harvest indicates that the fruit are over-ripe.

■ Shape

The fruit has an elongated cylindrical to oblong shape. The calyx cavity is deep and uniform. The stem cavity is firm and uniform with a lean and medium-length stem. The stem can cause cuts in the skin of neighbouring apples during transport and handling if precautions are not taken.

Moreover, it is also possible to find slightly hammered apples, often a sign of a young and imbalanced tree.

The appearance of deformation due to the impact of hail on young fruit is also observed.

Lastly, pollination defects can lead to distortions in fruit shape.

The Pink Lady® specifications keep the extent of these distortions in fruit shape to a strict minimum. The fruit sold to consumers must have the characteristic shape of the variety.

■ Size

Cripps Pink_{cov} has a **size potential varying from medium to large**, with the most common size being 75 mm.

However, the apples may reach very large sizes (> 85 mm), mainly in young orchards where the crop load – vigour balance is not reached.

The crop load and nutrition must therefore be carefully managed to obtain a uniform distribution of apple sizes.



The standard size demanded for the fruit is 75/80 mm. In the years where the weather promotes fruit growth or where there is a light crop load, there is the risk of having an excess of large fruit in stock which is hard to sell (except for some markets like Spain or Italy where there is a demand for very large sized fruit > 85 mm) and a shortage of small-sized fruit which is highly sought for promotional packaging (2 kg mainly) and in England especially for superior-quality fruit.

On the contrary, in case of over cropping or in a poor year for growth, sales management can be destabilised due to a shortage of the standard size (75/80 mm) and an excess supply of small-sized apples.

Striking the right balance in managing the crop load and nutrition avoids these pitfalls at harvest.

■ Taste quality

Taste

The fruit is subtly flavoured with a unique sugar/acid balance. Moreover, it is the acidity (8-9 g/l of malic acid upon harvest) that helps preserve the taste of the fruit during the storage period.

With regards to the sugar level, only **batches containing at least 13% Brix can be packaged under the Pink Lady® label.**

Texture

The flesh texture is fine to medium grained, crisp, and juicy with a creamy white colour. The firmness of Cripps Pink_{cov} is one of its assets and is subject to a strict selection during packaging: the firmness of the batch must be **at least 6 kg/cm², i.e. 13.5 lb.**

The management method and the harvest date determine the fruit's quality potential. The orientation of the batches upon arrival in the packing house and the management of the storage conditions are essential for this potential to be fully developed at the consumption stage.



“Surface defect” posters
to simplify packaging
and compliance with specifications

■ Zero defect target

The premium market ranking of Pink Lady® apples results in stringent “cosmetic” requirements. The aim is to reach a zero defect target by eliminating all defects such as blemish, roughness, colour defects, shape distortions, etc.

Fortunately, Cripps Pink_{cov} has agronomical qualities that help meet these criteria: a skin showing great resistance to friction damage (blemish), and average resistance to sunburn. Moreover the skin shows limited russet damage. The variety is also resistant to stem end splitting caused by rain close to harvest when the tree is not under stress.

On the other hand, Cripps Pink_{cov} is sensitive to impact, pressure and cracking.

Cracking is observed following rains on a stressed orchard or when the crop load is not properly managed.

The fruit is also sensitive to bruising and therefore must be handled with care right from harvest and during packing. The fruit’s sensitivity to bruising decreases after cold storage.

In both cases, the quality of the finished products depends on the way water and mineral nutrition are managed in the orchard.

■ Storage capacity

Cripps Pink_{cov} apples have **an excellent storage capacity**, enabling the fruit harvested in October or November to be marketed until as late as May. However, for this potential to be fully realised, it is important to determine the fruit’s optimal stage of maturity and start harvest at the appropriate time. The apples will be selected over multiple harvests.

Besides risks related to storage accidents (physiological disorders or fungal diseases), a very late harvest can also result in the formation of skin greasiness. **Sticky or oily fruit are not marketed under the Pink Lady® label** and are rejected. Very often, the entire batch will be rejected due to the risk of greasiness developing quickly.

Table 1: Marketing schedule

	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.
Europe	<div></div>								<div></div>			
Southern Hemisphere	<div></div>							<div></div>				

In the beginning, Pink Lady® was the sole brand and the apples that did not meet the high quality standards (while being compliant with category I standard) were marketed under the name of the Cripps Pink variety (currently under the Crip’s® brand).

With a view to optimise the sales and marketing approach, the Flavor Rose® brand was developed to supply certain distribution channels with fruit close to Pink Lady® standard; the only difference being an increased tolerance in regards to fruit colour (intensity and/or surface area).

The aim of fruit growers is straightforward – produce the maximum quantity of optimal fruit compliant with the Pink Lady® standards. Straightforward, however, does not necessarily mean easy. This manual aims at providing producers with the tools to succeed in doing so.



Chapter 2

Planting

All choices made during the planting stage will have a positive or negative effect on the entire life of the orchard. Numerous factors influence the orchard volume and its yield in the long term. The tree balance and the production quality depend on how well these factors are managed.





Characteristics of the variety

- Early flowering and late harvest
- Bi-coloured apple whose colour is sometimes hard to obtain
- Vigorous tree growth (Cripps Pink _{cov} clone).



Key points

Avoid frost prone plots

Plant in the North-South direction

Manage vigour by:

- appropriately selecting the root stock,
- correctly spacing out the orchard,
- regulating the height of the graft union,
- tree management.

Ensure the best practices are followed during planting:

- Preparing the soil the summer before planting,
- Irrigation installation,
- Immediate installing the trellis,
- Staking using bamboo, pegs, etc. or direct attachment to the trellis wire.



■ Planting the orchard

Selection of plot

Cripps Pink_{cov} is a variety that flowers early and is the last to harvest. When designing the orchard, it is important to **avoid frost-prone plots**, cold and heavy soil in order to eliminate the risk of either spring or autumn frosts.

The late harvest of Cripps Pink_{cov} means that orchards should not be located in areas that are very prone to weather **accidents at the end of season**. Thunderstorms and cyclones are more frequent after the autumn equinox and these can cause havoc in orchards if they are approaching harvest.

The trellis can very soon prove to be insufficient in sodden ground. The **formation of ruts** can cause lasting damage to the orchard. Production zones that are less exposed and protected by efficient **windbreaks** are preferred and should be implemented and maintained.

In very fertile soils, natural restitution of nitrogen can retrigger vegetative growth and prevent development of fruit colour. Improvement of colour is observed in low vigour orchards, sometimes with chalky soil.

Orientation of row

Right from the setting up of the orchards, proper steps need to be taken to ensure the development of an optimum fruit colour: importantly the **north-south orientation of the orchard is favourable for the development of colour** due to better exposure to sunlight.

In the case of the Mediterranean basin, the north-south orientation also ensures better protection against prevailing winds from the north and south.

The orchard must not be planted in the east-west direction. Only fruit at the front facing the south will obtain the desired colour. The fruit at the opposite end will stay **green and then turn yellow** without acquiring the commercially desired colour.



Height of the graft union
and planting on hills:
two means to manage the vigour



Graft union

At the time of plantation, **the height of the graft union** with respect to the soil surface is crucial in controlling the vigour of the trees and the uniformity of the orchard. When the graft union is too close to the soil surface, the graft may develop roots, resulting in excess vigour. When the graft union is too high, the resulting tree may be too weak.

In all cases, the graft unions spaced out at **irregular intervals** will result in **trees with non-uniform vigour** and an irregular orchard.

Planting distance

Excess vigour of trees has a negative impact on the colour and promotes the ageing of the orchard.

It is therefore important to properly manage the **planting distances** according to the rootstock, clone, soil fertility, vegetative growth conditions and the management mode selected for the orchard.

The between row space is commonly 3.50 m and more **often 4 m** due to the size of the machines.

Within the rows, managing distance between trees is related to the vigour of the variety/rootstock association; this spacing itself has an impact on tree development. Depending on the region, the trees are spaced out at **0.80 m to 1.80 m**. In some regions, especially in Italy, the plantations are sometimes more dense: 3.3 to 3.7 between rows and 0.8 to 1m in the row, i.e. 2,700 to 3,700 trees per hectare. Note: a very high density can prevent fruit colour development as Cripps Pink_{cov} is a high vigour variety.

For instance, table 2 illustrates the average densities of plantations carried out between 2002 and 2006 in the various production regions. The soil-climate conditions are decisive in selecting the right distance.

Table 2: Average plantation density from 2002 to 2006

Country / Region	Average plantation density by trees/ha
FRANCE (Average)	1,875
South-East	1,756
South-West	1,908
Val de Loire	2,215
ITALY (Average)	3,241
South Tyrol	3,448
Emilie Romagne	3,128
Other regions	2,577
SPAIN	1,986

Source: Star Fruits®

Pollination resources

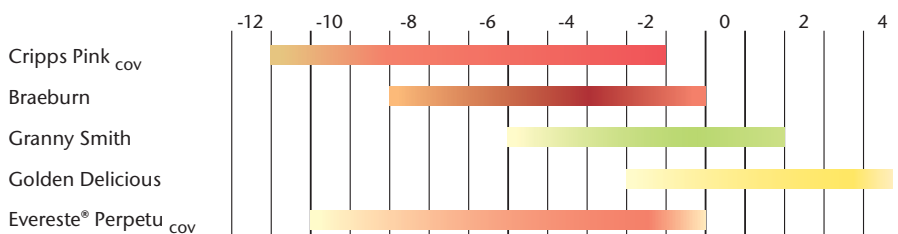
Cripps Pink_{cov} is **self-sterile**. As with other apple varieties, **cross-fertilisation** is necessary to obtain fruit in sufficient quantities and with a uniform shape. However, the high fertility of Cripps Pink_{cov} can justify a **moderate decrease** in the measures taken by the grower to promote pollination.

Therefore in regions having regularly optimal weather conditions during flowering, it is possible to reduce the presence of **pollinators** from 6-7 % to 4-5 %.

Only varieties that flower at an early stage must be used for pollination:

- either the **Malus pollinator PERPETU® Evereste** whose early flowering coincides with the blooming of the first flowers of Cripps Pink_{cov};
 - or the **Granny Smith** variety that is very resistant to bi-annual bearing and whose flowering coincides relatively well with that of Cripps Pink_{cov}.
- The early flowering of Braeburn makes it a suitable pollinator but the floriferousness of this variety is rather irregular.

Figure 1 : Synchronisation of flowering (number of days)



■ Other important factors

Levelling of feathers

The conservation of secondary shoots depends on the orchard management system and **their quality**. Secondary shoots that are too many in number, too close to the ground, too close to each other or that have close angles must be eliminated during planting. A **protection of serious pruning wounds** will be required to avoid drying out of one-year old trees or contamination by canker.

Preparation of soil

Soil preparation influences the root development and as a result indirectly influences the growth of the young tree.

In the summer before planting is to begin, ensure that lifting operations are planned out and the soil is prepared in good condition.

Planting on hills can be considered for many reasons: quicker warming up of soil at the end of winter, quicker drying up of soil in wet areas. These hills may however increase the risk of sucker growth and re-development of rootstock at the foot of the trees which will require additional management. Moreover, chemical weed control and harvesting operations are often more difficult on the slopes of hills.

These hills, nevertheless, if required can be reduced or removed to “give height to the graft union” and in this way reduce tree growth in case of excess vigour.



Dry one-year old tree
and the resumption of growth
at the graft union:
non-uniform orchard

Planting material

QUALITY OF ONE-YEAR OLD TREES

To preserve the quality of one-year old trees, it is important to:

- **avoid planting them too early**, give the young one-year old trees enough time **to rest** before lifting in the nursery,
- ensure good storage and transport conditions to prevent the **one-year old trees from drying out**,
- remember to water the trenches if the weather conditions delay planting after delivery of the one-year old trees.

Good agricultural practices
during planting:
stalking and irrigation



CHOICE OF CLONE

Rosy Glow_{cov} is a natural mutation of the original Cripps Pink_{cov} variety. This new selection shows **improved colour** at an equivalent stage of maturity. The colour appears at an early stage and on a wider surface of the fruit including areas in the shade. This advantage prevents the offset between the physiological maturity and the commercial colour.

This new clone is preferred in orchards in production regions with mild autumns where fruit colour is hard to obtain.

A virus-free clone is now available. Rosy Glow_{cov} has been awaiting French Certification since 2007, when the healthy clones were first grafted. The first virus-free one-year old trees will be available in Europe as of 2008-2009.

■ To be followed...

Vigour of Rosy Glow_{cov}

The initial observations made with a viral clone of this new selection showed reduced vigour in comparison with the certified Cripps Pink_{cov} variety.

The vigour of the Rosy Glow_{cov} healthy clone is yet to be tested.



Chapter 3

Tree Management

Cripps Pink _{cov} is one of the highest performing varieties on an agronomical level. The tree is easy to manage, capable of regularly bearing rich loads of fruit without showing any marked bi-annual bearing or a negative impact on its vegetative growth. However, obtaining high-quality fruit is not an easy task.



Tree in first leaf.
The branches are erected.



Characteristics of the variety

Strong vigour
(10 % higher
than Golden Delicious):

- Low vigour is sometimes observed during the initial years in some orchards,
- Capacity to grow despite aging and fruiting,
- Excess vigour is possible leading to poor colour.

Erect or semi-erect habit
that droops with fruiting

Good branching potential:

- sturdy branches,
- bourse fruiting,
- large bourse volume,
- presence of numerous crowned brindles,
- densely ramified branches,
- low to medium reiteration.

Dominance of central leader on branches: medium to low.



TREE MANAGEMENT: DEVELOPMENT PHASE



Debudding
upon start of plant growth



Key points in the tree development phase

**Systematically remove the competing branch(es)
at the terminal shoot by:**

- debudding (when the one year old tree starts to grow),
- lifting (in case of shoots less than 10 cm),
- pinching (in May or June).

Repeat the operation as many times as required

Organise branches into levels and distribute them in volume

Avoid

- tight manual and premature shoot bending as it leads to massive reiteration,
- avoid systematic and standardised tying which blocks sunlight.



Monitoring the growth
of semi-erect branches
during the development phase



■ Development of young trees

The following recommendations concern orchards grown in the French Axis, the most widespread fruit form for Cripps Pink_{cov}. Constant research is being carried out on optimising tree growth. Other approaches may be implemented in some regions leading to different practices (double axe or the spindle for example).

- **Monitor the development of these semi-erect branches with low bearing:**
 - identify these branches at an early stage,
 - remove the ones showing strong vigorous growth if required,
 - manually position them without forcing (at an angle of about 120°) to avoid reiteration and rapid aging of the branch,
 - use iron wire, twist-tie, elastic thread, etc. to position these branches.
- **Maintain the branches** that do not directly compete with the central leader above the tree, to compensate for basitony and allow better balance of the tree.

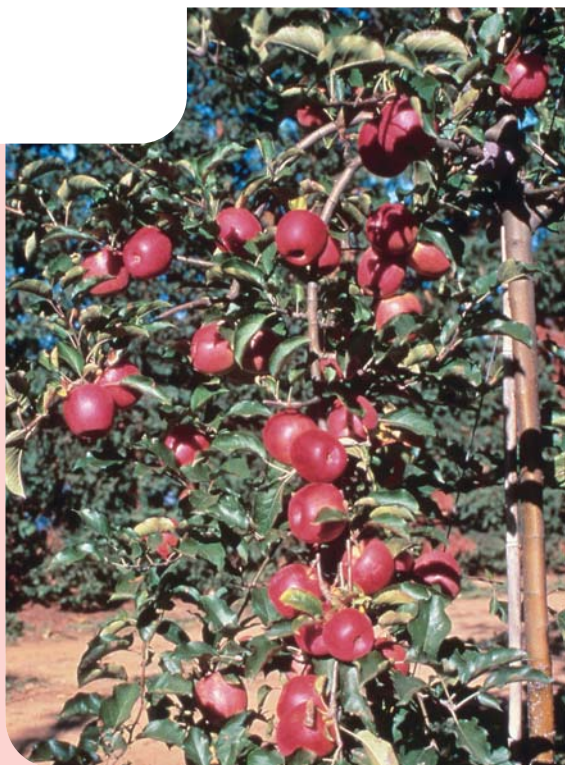


Branch competing
with the central leader

- **Remove branches competing with the central leader** located at the same insertion node. Prematurely remove one or two buds by debudding at stage C3-D (green tip).
- **Organise branching into levels:**
 - distribute them spirally in a uniform way throughout the entire volume,
 - avoid branches from piling on as this blocks sunlight.
- **Carry out all operations at an early stage and in summer** to fully tap into the trees growth potential.

TREE MANAGEMENT: FRUITING PHASE

Balanced Cripps Pink_{cov}
fruiting branch –
Uniform size and colour



Managing the fruiting branch is the main issue. The Cripps Pink_{cov} fruiting branch usually shows balanced growth. Production can be managed with or without artificial extinction while keeping in mind the need to have a porous hedge and reduce fruiting points.



Key points in the fruiting phase

Encourage exposure to sunlight to improve colour

Manage crop load and quality of fruiting

Avoid insufficient pruning.

■ Winter pruning

Fruiting pruning / extinction

- **Organise the fruiting branches through winter pruning:**
 - remove branches that show too much vigour, are low or in excess,
 - avoid overlapping,
 - only retain a **single production** level by removing branches at a lower level as and when the branches at the higher level develop and extend out.
- **Do not neglect fruiting branches:**
 - remove brindles or branches that are too close to each other,
 - remove fruiting points below the branch and at the intersection points of the branches,
 - strip the first few centimetres of the branch to allow light to enter through the tree canopy,
 - remove the erect branches that may easily grow to become watershoots,
 - in the end, the branching must be allowed only on a single level.
- **Allow light to enter through the tree canopy (create a light well).**

Manage crop load

- **Remove the excess fruiting points**, starting with branches with a very thin lower section of 8-10 mm.
- **The appearance** of the Cripps Pink_{cov} tree in winter **is deceptive**. The optimal architecture of the tree is misleading with regards to the number of fruiting points.
- **The variety is fertile**: only a few buds will be exclusively vegetative. Most (+90%) of the buds arising from the growth of bourses will result in a return bloom after fruiting.
- **Proceed to counting** or use the **Equilifruit** counting tool to adjust pruning level.
- **An excessively light winter pruning will considerably lower the economic results of the orchard** by resulting in a poor colour due to excessive shade and overload.

Refer to the following chapter and the sheet “PINK LADY® – Manage fruit load” – Mafcot/APLE, with Equilifruit PINK LADY®.

Bourse fruiting
and crowned brindles ensure
the regularity
and quality of the production



Position branches

The strong vigour of the variety and its poor capacity to produce fruit upon erect branches may require manual action in some cases. The operation involves shoot bending to speed up fruiting and minimise shade. To ensure that the operation is effective, it is advisable to wait for the physiological drop to end. In fact, beyond this stage, either fruiting is sufficient and the weight of the fruit causes the branches to droop or the branches are manually tied down. Standard devices such as twist-ties, elastic, iron wire, weight, etc. can be used to position the branches horizontally and strike the right balance between vigour and production. Excessive bending at over 45° horizontally will result in imbalance along with:

- appearance of reiterations,
- overlapping of sagging branches,
- loss of light penetration.





Opening allowing sunlight
to enter – light well
Photo GRCETA Basse Durance

■ Summer pruning

- **Remove reiterations** that may hamper the development of fruiting branches.
- **Help improve colour** by better exposure to sunlight.

This operation must be carried out when there is no heavy sunshine and chances of sunburn, i.e. when the young fruit start to turn and/or before periods of a steep rise in temperature: before mid June or in September.

A first visit can be made as early as May when the branches can be manually removed very easily.

Note: Summer pruning must not be carried out in regions where fire blight (caused by *Erwinia amylovora*) is rampant in order to prevent the bacteria from spreading.



Equipment for root pruning
Photo J.-P. Dupin –
SCA Anjou orchards



■ Food for thought

Manage vigour

LATE PRUNING

In the Val de Loire region, there is a practice well adapted to orchards with strong vigour: pruning is delayed and carried out after flowering and mainly the selection of fruiting branches by pruning or extinction. Pruning at this date reduces vigour, improves colour by spacing out the fruiting points and saves summer pruning. This operation may result in a slight decrease in fruit size.

ROOT PRUNING

Root pruning is also effective in controlling excess vigour. The roots must be pruned before the end of January at a depth of 30 to 40 cm and generally on a single side.

The plough coulter is used at 40 to 50 cm from the trunk.

In plantations where sprinkler or gravity irrigation is used, the pruning distance must be increased depending on the volume of root development.

In all cases plan for technical assistance:

- reduce the number of fruiting branches accordingly (the largest fruiting branches and the ones competing with the trunk),
- ensure a steady supply of water and minerals right from the early stage. The dose must be adapted according to the reaction of the trees estimated from the colour of the foliage.

GROWTH REGULATORS

The use of Regalis® is another way of reducing vegetative growth. The periods, conditions and dose to be administered must be discussed with the technical advisor of the orchard.



Cripps Pink_{COV} orchard
managed on Fruit Walls
Picture from EPLEA Louis Giraud - Carpentras

Fruit Wall

The first experiments in adapting the Cripps Pink_{COV} variety to be managed on fruit walls in several experimental sites showed interesting agronomical results, yielding fruit in line with sales expectations. However, to ensure the technical success of Cripps Pink_{COV}, the fruit wall concept must be adapted to the specificities of the variety. The following main points must be taken into consideration:

- select the most colourful clone,
- plan an orchard right from planting preferably preformed one year old trees with at least two central leaders. **Do not transform existing orchards into the central leader,**
- in an adult orchard maintain a thin leafing of 30 to 35 cm on each half-side,
- carry out the summer mechanical pinching commonly called “topping” at the stage 12 to 14 leaves, avoid operations at very early stages as they may be harmful to the colour,
- encourage growth of young plants and natural opening of fruit supports, the first topping operation must be carried out only on the 2nd or 3rd leaf depending on the vigour of the orchard,
- retain a maximum of 25 fruit (± 3 fruit) per side and m²,
- carry out a yearly and meticulous additional winter pruning especially focusing on forgotten, competitive and sagging branches to ensure that the fruit are well exposed to light,

It must be noted that a Fruit Wall generally results in a slight delay in the appearance of fruit colour. In return, this management mode ensures uniform fruit colour and reduces the number of harvest rounds.

■ Testimonial

FRUILAR (Lerida zone - Spain) started their Cripps Pink_{cov} plantations in 1997. After the first few years of production, the growers were soon faced with several problems, especially vigour management with several unbalanced orchards. The reasons for this imbalance were identified: rootstock used, soil variability and management of heterogeneous orchards.

To resolve these problems, FRUILAR implemented the following solutions:

- **Improving tree development:**
 - tree training when a height of 1.20 m is attained,
 - removing weak branches,
 - maintaining flow of sap to fruiting branches and keeping them tied down,
 - improving canopy porosity and exposure to light.
- **Adopting centrifugal management** (complex branches, light well, etc.).

These technical solutions have been found and implemented by organising technical meetings and providing growers with on-site support.



Chapter 4

Crop load management

The agronomical performance of the Cripps Pink_{cov} variety enables the tree to bear a heavy crop load. Note: the high fertility, good production potential and vigour ensure excellent tonnage but may have a negative impact on the fruit colour and quality. Managing crop load is essential for meeting the requirements of the Pink Lady® brand.

The ideal crop load is the one that:

- is in line with the orchard's/plot's potential,
- yields the highest percentage of premium choice fruit,
- is compatible with regular return bloom.

This definition takes into account the soil conditions that bring out the best of the variety's potential.

The results can however be enhanced by adapting cultivation practices to the soil-climate zones: centrifugal pruning, summer pruning, soil or foliar fertilisation, water restriction, installing reflective mulches, etc.).





Characteristics of the variety

- Good response to thinning agents:
 - however risk of over thinning.
- No predisposition to pygmy fruit:
 - risk-free use of auxins in a programme cycle or in association with another molecule.
- Slow growth of young fruit and good differentiation of the king fruit:
 - wide scope of application.
- Strong size potential:
 - standard commercial size maintained despite heavy crop loads
 - pre-flowering operations not mandatory.
- Good return bloom:
 - pre-flowering operations not mandatory.



Key points of the crop load management

Reducing the number of fruiting points

Adapting the fruit load to the orchard's colour potential

Focusing on a balanced distribution of sizes.



The crop load in the orchard could initially be:

- **light:** production level suffers due to poor weather conditions (frost, cold and wet conditions during pollination), over-thinning or flower-drop,
- **adapted:** right balance between winter pruning, chemical thinning and tree volume,
- **heavy:** insufficient pruning and/or extinction, inefficient chemical thinning, under estimation of fruit load due to absence of counting.

Table 3: Impact of fruit load on the orchard

	Light	Adapted	Heavy
Vegetative growth	Excessive	Average	Sometimes poor
Return bloom	Too high, many flowers on the current year shoot	Good to very good	Uniform flowering rate but low risk of bi-annual bearing Risk of impact on colour the subsequent year
Harvest	Less spread out	Maximum 4 rounds	More than 4 rounds
Colour	Often good except in case of excessively strong vigour)	Good	Poor
Background color	Attractive	Attractive	Makes fruit less attractive
Ripeness	Optimal	Optimal	Over-ripeness because of waiting for a colour hard to obtain
Size	Often excessive	Optimal	Average
Fruit shape	Poor	Average	Average
Sugar level	Very good or good	Good	Poor (restricts access to some markets)
Acidity	Optimal	Optimal	Reduces overall quality
Firmness	Optimal	Optimal	Loss of firmness due to over-ripeness arising from spread out harvests
Yield	< 30 t/hectare	50-60 t/hectare	> 70 t/hectare

Source : Élaboration Ctifl

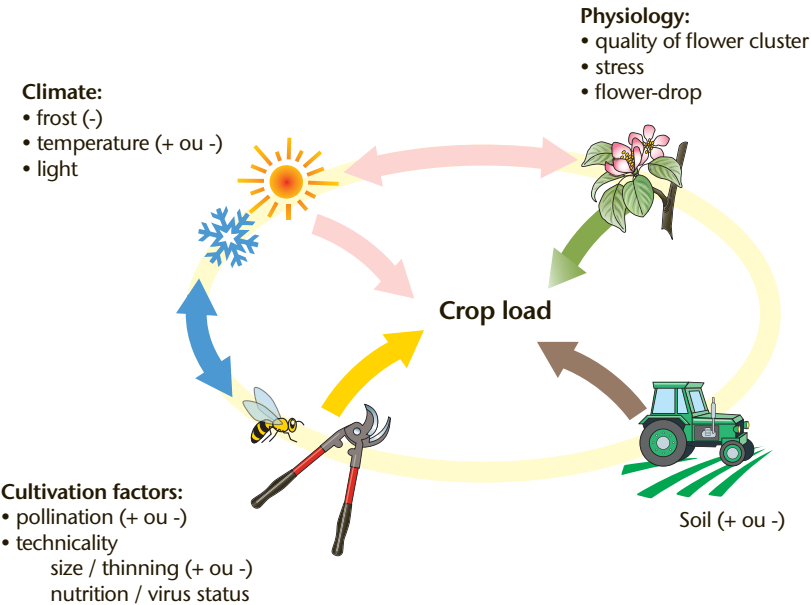


Table 4: Impact of crop load on the sales distribution channel

	Light	Adapted	Heavy
Risk management during storage	Risk of flesh browning	Minimised	Risk of greasy fruit
Marketing	Reather quick	Long and calm	Quick due to loos of firmness
Sales impact	Too many large-size fruit Non-uniform batches	Optimal	Too many second choice fruit
Customer satisfaction	High but there is risk of flesh browning	High	Low
Conformity with brand requirements	Good	Good	Poor

Source : Élaboration Ctiff

Figure 2: Factors influencing crop load



■ Assess the orchard’s production potential in its soil-climate zone

An indispensable indicator: the percentage and tonnage of fruit marketed under the PINK LADY® brand.

- Indicators of excess fruit load:**
- the number of harvest rounds (more than 4),
 - late harvest end,
 - pale rose colour failing to evolve,
 - a very high percentage of second grade fruit or culls.

Besides the percentage and tonnage of premium choice fruit, it is also important to know the average size obtained to convert the tonnage/hectare into the number of fruit per tree.

Each orchard has a threshold beyond which, **increase in tonnage fails to increase the profit margin**. The sales suffer a setback and expenses increase.

Table 5 is a guide only. The values will be different depending on the shape of the fruit influenced by soil-climate conditions and the age of the parent branch.

Table 5: Average weight and number of fruit per kilo and per size

Diameter (mm)	65-70	70-75	75-80	80-85	85-90
Weight (g)	121-153	153-185	185-217	217-250	250-282
Number of fruit per kg	7 to 8	6	5	4 to 5	3 to 4



Equilifruit PINK LADY®
that comes with the sheet
“PINK LADY® – Manage fruit load” –
Mafcot



Once these elements are known and decided, the number of fruit per tree, which will form the basis for controlling the orchard, can be calculated using the following formula:

$$\text{Number of fruits per tree} = \frac{(\text{Desired Tonnage} \times \text{Number of fruit per kg})}{\text{Number of fruit per hectare}}$$

The number of fruit per tree can be used as such or be expressed as number of fruit **per cm² of branch cross section**. In this case, the average sum of the branch sections per tree is included in the calculation.

Once the orchard's crop load potential is determined, Equilifruit can be used to rapidly check if the number of floral buds (at the time of extinction) or the number of fruit (at the time of manual thinning) corresponds to the set objectives. In fact, for branch sections of 8 to 28 mm, it gives the number of buds or fruit corresponding to the desired load. The Pink Lady® Equilifruit is designed on a basis of 6 fruit per cm² of branch section, which corresponds in most cases to a fruit load adapted to the Cripps Pink_{cov} potential.



■ Production objectives

Setting the risk level for chemical thinning

– **High risk:** for minimum manual thinning with the risk of over thinning and consequently other risks related to an insufficient crop load (see table 3 and 4).

– **Low risk:** by keeping a safety margin that may prove to be costly with respect to manual thinning.

The variety's excellent potential in terms of its size, low bi-annual bearing, and organoleptic qualities, will restrict the consequences of an insufficient chemical thinning "strictly" to a financial level related to the manual adaptation of the load.

This risk level must be taken into account while managing thinning. In fact, the success of chemical thinning depends on several factors and cannot be anticipated in advance.

All elements disturbing the physiological state of the tree (stress, parasitism, etc.) have an influence on the response, which in turn is related to the orchard's conditions (vigour, flowering rate, etc.).

The weather conditions during and around the period of application influence the penetration and migration of products into the plant, and subsequently modify the duration and intensity of biological processes (avoid temperatures lower than 15°C and low relative humidity).

Aiming for a balanced distribution of sizes

Reducing fruit load to obtain better colour must not **compromise the fruit size**. Especially in regions where autumn is mild or weather conditions are not conducive to obtaining a good colour, it is important to act on other factors regardless of the fruit load.

The grower will turn to technical aspects that influence colour: summer pruning, intensity of winter pruning, nutrition, irrigation, vigour management, leaf pruning. (Refer to corresponding sheets)



Manage crop load

The crop load is managed via **three indispensable cultivation operations carried out one after the other**:

- branch thinning and fruiting pruning (with or without extinction),
- chemical thinning,
- manual thinning.

Each operation depends on the previous one and plays its part in the **overall management of the crop load**. The intensity of each technique will be adapted depending on the specific reactions of each orchard (vigour, weather and pollen conditions, etc.). **This decision must be taken by the grower assisted by his technical team.**



■ Chemical thinning

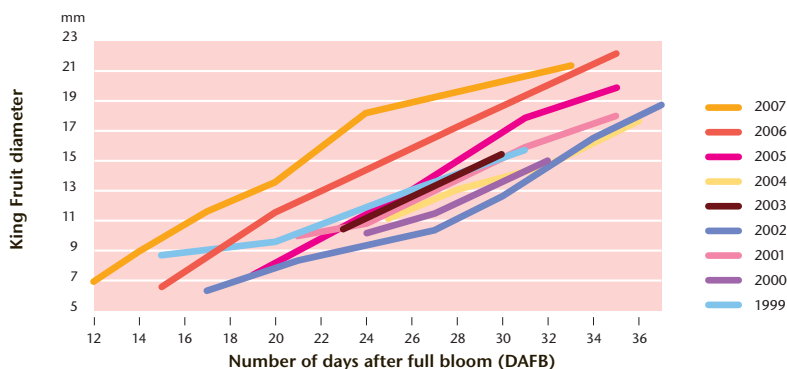
Take into account

- **Risk of flower-drop** = insufficient fruiting linked to crop load greater than the orchard's potential the previous year.
- **Risk of mechanical drop** exceeding three fruit per flower cluster.
- **Commercial risks:**
 - good organoleptic quality requirement,
 - marked grade difference between premium choice and second choice fruit,
 - sensitivity to senescent flesh browning in case of light fruit load.
- **Staggering of flowering on current year shoot:**
 - change in the orchard protection schedule.

Manage thinning

- **Plot by plot approach:** flowering rate, pollination resources, etc.
- **Depending upon the weather conditions of the year:** pollination levels, temperature, wind, rain, frost, etc.
- **The criteria for treatment should be the average diameter of the king fruit on the clusters on old wood rather than the number of days after full bloom (F2 Fleckinger).** High temperatures after flowering may significantly increase the rate of fruit development and growth. Thus, in 2007, a 15 mm king fruit size was obtained 12 days earlier as compared to the early 2000s.

Figure 3: Annual growth of king fruit diameter with number of days after F2 (France - Rhône Méditerranée region - Ctifl Balandran)



It's important to measure the growth of the fruit directly in the orchard (see figure 3).

This point has become ever more important given that carbaryl (SEVIN® L 85) will be withdrawn from the market as of end 2008.

- **Learn to use new substances**, each of which have their own specific characteristics,
- Seek advice from technical department.

Chemical thinning is not a set practice. The programmes will be drawn up depending on the observations made and previous or shared experiences.

Keep abreast regularly of new registrations and withdrawals! Printed documentation cannot take into account a rapidly changing regulation on agro-pharmaceutical specialities.

Official websites

– *French Ministry of Agriculture and Fishing:*

<http://e-phy.agriculture.gouv.fr>

– *Official Spanish website:*

www.mapa.es/es/agricultura/agricultura.htm

– *Italian Ministry of Agriculture:*

www.politicheagricole.it

■ Additional hand thinning: profitable operations

- Closely adjust the crop load to the set yield targets: organoleptic quality, colour, etc.
- Improve the harvested premium produce quality by discarding small, distorted, blemished fruit or fruit attacked by bio-aggressors or light hail.
- Minimise the risk of mechanical fruit drop on flower clusters having more than three fruit.
- Reduce the share of fruit born on the current year shoot (smaller, atypical shape, potentially more sensitive to senescence flesh browning and causing bi-annual bearing).
- Additional manual thinning costs compensated by increase in the share of premium produce and improved harvest speed.



On the left:
Marking obtained by the drop
of a manually thinned fruit
from the tree top

On the right:
Premature sunburn

- Adapt the number of fruit per flower cluster to the orchard's size potential. Do not standardise one fruit per flower cluster. If excessive size is observed, reduce the number of fruiting points and allow two fruit per flower cluster.
- Ensure that fruit at the tree top do not fall on the ones at the bottom as this may result in the appearance of markings as early as manual thinning.
- Protect fruit from premature sunburns that may occur at an early stage. Manual thinning must be carried out before periods of heavy sunshine that may be present right from mid June.

■ Upcoming perspectives and new products

The tests conducted by the national working group on Thinning Ctifl/Regional Experimentation Centres showed that despite the withdrawal of Carbaryl (SEVIN® L85), the registered substances and the ones pending registration yield very good results when used in the chemical thinning of Cripps Pink_{cov}.

All information related to these commercial products will be published by the usual channels after registration.



■ Testimonial

Bertrand Rehlinger grows 38 hectares of apple trees, 2 hectares of kiwi trees and 2 hectares of cherry trees in the village of La Bastide St Pierre in the Tarn et Garonne region in south-east France. One of the special features of his plantation is that Pink Lady® Cripps Pink_{cov} accounts for 1/5th of the apple orchard. This significant investment has led him to closely monitor his production yield.

It appears that the soil-climate conditions of south-east France bring out the rich agronomic potential of Cripps Pink_{cov}. A production volume of 70 tonnes / hectare is easily reached with a size that is still too large in comparison with standard commercial requirements. Bertrand Rehlinger has also observed that the variety responds well, sometimes too well, to chemical thinning.

The desire to adapt the fruit size distribution to market requirements led the grower to increase the yield to 80 or even 90 tonnes/hectare.

The yield in the year following such a harvest can steeply drop to 45 or even 40 tonnes/hectare. The phenomenon of flower-drop rather than bi-annual bearing is responsible for this sharp decline in tonnage.

This phenomenon is further amplified by chemical thinning. Only the absence of specific treatment allows an optimal production level to be maintained.

Fruit load management is one of the major issues requiring Bertrand Rehlinger's attention. At spring time, he must assess the risk of flower drop due to the previous year's production and must consequently be cautious in his thinning programme. Moreover, any error in assessment and over caution is likely to negatively impact on the production cost and colour level.

Bertrand is more reassured on another matter: reducing irrigation as of the end of August guarantees him the desired distribution of apple sizes.

Moreover, the grower has also adapted his pollination resources by including the Perpetu® Evereste_{cov} variety among Granny Smith trees. Some years, this variety flowers rather late and does not cover the flowering time of Cripps Pink_{cov}. Load deficiencies can nevertheless be attributed to the choice of Granny Smith as pollinator.

Chapter 5

Nutrition - Soil management

Investing in a Cripps Pink^{cov} orchard is worthwhile only if the “Pink Lady®” venture is given its fair chance to succeed. After selecting an appropriate plot and taking special care in preparing the soil, the focus should not be limited to acquiring proper equipment and irrigation system. It must also be on tools and resources that guide the grower in taking decisions to manage water and fertilizers.

The quality of the fruit depends on its composition and thus on the nutritive elements supplied. The conditions of growth and development of the tree also govern the quality. It is precisely at this level that fertilisation and water supply come into play by interacting with the mineral balance of the soil and the climate.





Characteristics of the variety

- Long seasonal development
- Sensitive to impacts and bruises
- Fruit size tends to be larger than standard
- Minimum sugar content requirement to be marketed under the Pink Lady® brand
- Sensitive to cracking
- Premature leaf fall observed occasionally.



Key points

Manage irrigation to:

- minimise cracking,
- control fruit size,
- increase sugar content.

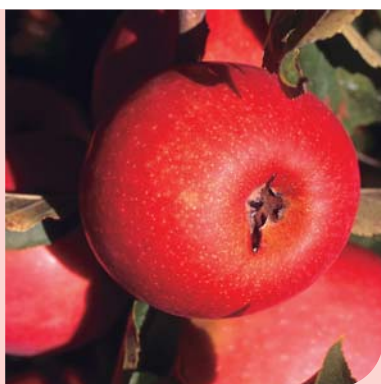
Provide phosphorous to reduce sensitivity to bruises

Provide calcium to young orchards and in vigorous conditions (excess vigour, light fruit load, etc.)

Manage nitrogen to control vigour and enhance skin colour

Promote and maintain a well aerated soil (root growth, flow of water, no anaerobic soil conditions).





Cracking
due to interrupted irrigation

■ Irrigation

- **Avoid disturbing the growth of trees** due to interrupted irrigation resulting from:
 - irrigation management techniques that are not reactive enough to weather conditions,
 - defective irrigation systems that are not flexible, scalable and adapted to the soil type,
 - soil damaged by inadequate preparation before plantation or several operations carried out with heavy equipment in autumn, winter or spring.

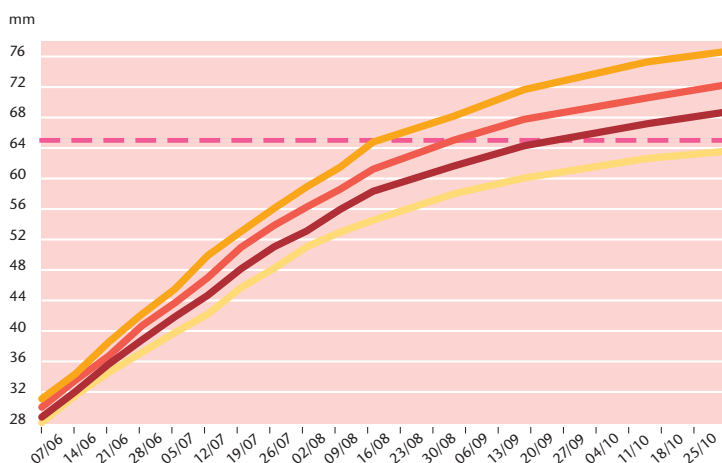
Interrupted irrigation can lead to problems with the uptake of minerals resulting in size loss, cracking, bruises and poor storage capacity.

- **Regularly monitoring of fruit growth** is a good way of managing irrigation. Figure 4 shows four growth scenarios. Comparing statistical findings at a given time on a plot helps:
 - visualise the tentative fruit size at the time of harvest,
 - detect fruit sizes to be eliminated during manual operation,
 - manage irrigation by reducing or increasing intake of nutrients in line with the set objectives.



Figure 4: Four scenarios depicting fruit growth – Observation 2004

Source Cofrud'oc



■ Nutrition

With regards to nutrition management it is advisable to comply with standard practices applicable to any other apple variety. There has been no specific study conducted that would add to any previously acquired knowledge. Sound cultivation methods, especially the spread out application of nitrogen-based fertiliser remain a crucial.

Leaves can be sprayed with phosphorous to increase resistance to bruises.

To do this:

- start supplying nutrients upon petal fall,
- plan 2-3 applications at intervals of 15 days (adapt programme to the commercial preparation).

■ Monitoring and maintaining soil structure

Maintaining a porous soil structure promotes root growth, flow of water, and helps reduce stress in trees.

Special care of soils prone to capping

These types of soil:

- generally have less than 10 to 15 % of pebbles,
- have a structure classified as “silty - ***” or “silt - ***” in the GEPPA soil texture triangle,
- have a capping index greater than 1.8.

Look out for the symptoms of a compacting soil

These symptoms are:

- premature leaf fall,
- late start of spring vegetation,
- appearance of cracking,
- lack of vigour,
- presence of puddles during irrigation,
- rapid distribution of water in case of gravity irrigation,
- excess water conditions: floods, canopy spray irrigation, frost protection, gravity irrigation, etc.,
- tensiometer values remain high even after irrigation.

A partial solution

- Loosen the soil between the rows after harvest or in spring:
 - on a dry soil to promote abundance,
 - using preferably an adapted caterpillar tractor (can be rented or service provided).
- Make observations when soil is compact:
 - by the opening up holes,
 - by using a compactometer on soil close to the field capacity (can be rented or service provided).

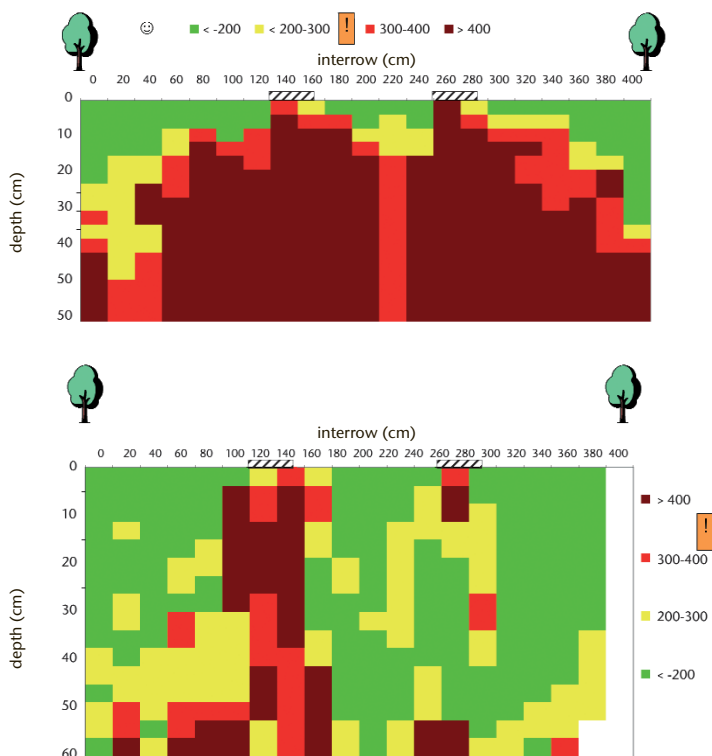


Figure 5: Illustration of the use of “compactometer” in two contrasting orchard conditions:

Top - serious situation where the whole soil in between rows is compact and requires attention.

Bottom - case conducive to root development where the soil is compacted by the wheels.

(Source GRCETA Basse Durance)



Prophylaxis always yields positive results

To limit soil compaction:

- use a tractor with low-pressure tyres or tyres with tracks,
- adapt tyre pressure according to the type of operation to be carried out (general tendency to over-inflate),
- adapt tools by promoting weight gain.



Poor color

■ Food for thought

- **Influence of nitrogen on maturity and colour**

Nitrogen-rich soils, unlike the ones poor in nitrogen, result in poor fruit colour upon maturity:

- avoid plots with excessive organic matter,
- reduce supply of organic products upon plantation and during cultivation,
- stop supply of nitrogen at the end of the season.

Note: These recommendations unlike best practices are specifically meant for the Cripps Pink_{cov} variety. They have adverse effects on the soil structure and consequently the flow of water in the soil.

- **Control fruit size by regulating water intake and:**

- ensuring adequate supply of water during cell division (from flowering to the initial 40 to 50 days of the fruit life),
- reducing supply of nutrients after physiological drop and until the stop of branch growth controls vigour and fruit size,
- reducing supply of nutrients in the last month improves sugar content,
- adapting the ration to each plot. **DO NOT HOMOGENIZE UNDER ANY CIRCUMSTANCES.**

■ Testimonial

Vincent Gaillet grows apples (60 hectares) and pears (15 hectares) in Saint Andiol (Bouches du Rhône – south east France).

For several years, he complained of the poor vigour of his orchards and insufficient fruit size even during a year of low production (year off in case of bi-annual bearing). Examining the reasons for this poor growth, led him to shift his focus to the soil of his orchards.

The trenches built showed that water failed to properly penetrate into the soil, and did not reach the roots of the trees. Since increasing irrigation volume did not prove to be efficient, Vincent Gaillet turned to the use of a decompactor. This tool is fitted with thin blades curved on the sides covering the whole working width. The “natural” vibration of the blades breaks up the soil on the entire working volume without lifting the big components and altering the profile. Since the soil surface is not damaged, these blades can be used to frequently loosen the working tracks of permanent sod-cultures.

In the first year when compacting was observed, each working track and row is worked with off centred blades. Once the loosened soil resumed normal functioning by improved circulation of water, the soil was then worked using a single blade on the working track and on every alternate row. This operation is carried out after harvest at a depth of 40 cm. Care must be taken to not damage the roots.

The result is seen the following season. With the improved water supply, the trees display greener foliage. Growth is back to normal and the tree bears two to three different sizes of fruit.



Chapter 6

Harvest

All efforts put into managing the orchard could be in vain if the harvest is not properly managed. Assessing the stage of maturity and starting harvest are two key factors in managing the Cripps Pink _{cov} variety. The short and medium term profitability of the orchard depends on this management. Assessing the stage of maturity is crucial as there are strong chances of the fruit becoming over-ripe. Over-ripe fruit will negatively impact on the packing station and the market management. Marketing policies can only be efficient if the product meets consumer expectations.





Characteristics of the variety

- Late harvest:
 - first round as of mid October in the most early-maturing areas,
 - risk of autumn frost.
- Fragile fruit sensitive to cuts and bruises
- Selective harvest based on the intensity of colour
- Special attention to problems arising from very late harvest:
 - insufficient firmness,
 - cottony texture,
 - unattractive background colour,
 - “greasy” skin,
 - senescent scald,
 - flesh browning,
 - rot diseases such as phytophthora or lenticel rot.



Key points

Do not risk over-ripeness by waiting for a colour that will not be attained

Organise a team of adapted fruit pickers

Properly determine the start date of harvest

Ensure that the first round of harvest is carried out at the earliest and the subsequent rounds at least once a week.



Harvest set-up

Place the fruits directly into the pallet bins

Wound caused by the pallet bin plank

■ Harvest organisational set up

Harvest management depends on two factors: start date and harvest organisational set-up.

- **Do not start too late:**
delaying the first round to increase the share of fruit harvested is a mistake. Harvest the coloured fruit as soon as the right maturity is attained. This first clearing of fruit load is beneficial to the development of the remaining fruit.
- **Do not cut down on the size of teams:**
do not reduce the size of teams as few days of rain regularly delay the harvest set up.
- **At least perform one round per week.**
- **Do not reduce the number of rounds:**
reducing the number of rounds will certainly have an adverse effect on the uniformity and overall quality of the harvest.
- **Draw from the previous experiences to set deadlines:**
if the weather conditions are not good, it is no use waiting. Beyond a certain stage of development, the fruit colour stays pale and fails to develop as anthocyanin is no longer synthesised in sufficient quantities to produce a red colour.





■ Harvest precautions

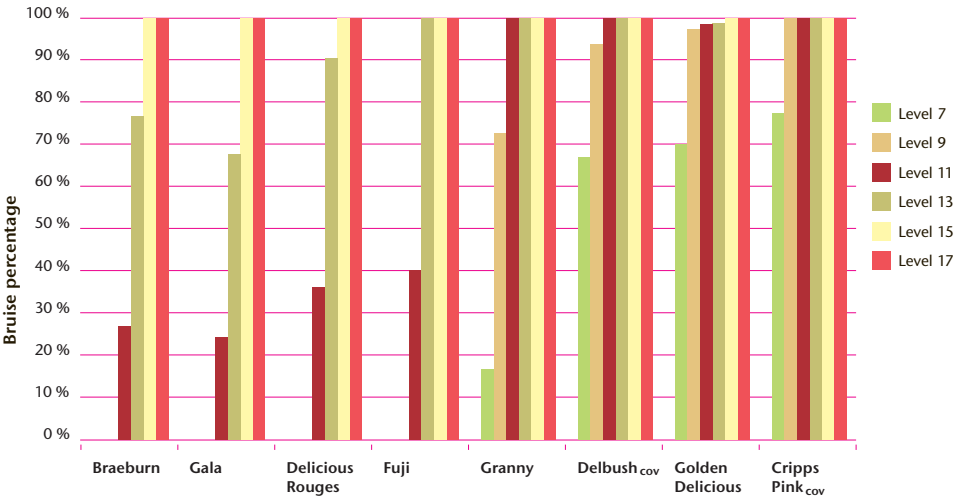
In the orchard

The fruit is fragile and sensitive to cuts and markings. They must be handled with care.

- Avoid using picking bags and place the fruit directly into the pallet bins.
- Do not completely fill the pallet bins.
- Use plastic pallet bins or new wooden pallet bins for better rigidity.
- Use bubble plastic or rot-proof foam at the bottom to reduce impact.
- Train and supervise fruit pickers.
- Perform quality control.
- Bear in mind to train and inspect tractor drivers, forklift truck drivers and drivers.
- Improve headland and access paths by filling up holes and ruts;
- Do not harvest on rainy days and on days following rain or on white frost mornings.
- Prevent mud from entering the packing-house when harvest is performed under muddy conditions to curtail the risk of phytophthora contamination.
- Treat fruit for post harvest disease: phytophthora, lenticel rot, scab, flyspeck and sooty blotch.
- Improve resistance of fruit through a balanced supply of nutrients (see corresponding sheet).



Figure 6: Illustration of fruit sensitivity to bruises: percentage of fruit marked after falling from a weight from different heights (Sensifel© Ctifl 2003)





In packing house

- Do not grade fruit too soon following harvest. It is important that they “loose” some water before being handled (ventilation, etc.), to make them less turgid and more resistant to impacts.
- Reduce the speed of the packing line.
- Ensure protection during transfer or in case of fall.
- Use solid inner tray for protection against impacts.

■ When and how to start harvest?

Regular monitoring of the development of maturity

Rigorous sampling and accurate tools must be used to regularly monitor the physiological maturity to obtain optimum quality fruit. It is important that the maturity measurement is based on the results of several tests.

METHODOLOGY TO FOLLOW

- Take samples of about thirty representative fruit from a plot, corresponding to the harvest round to be tested.
- In case of non-uniformity take samples from each plot and perform several tests.
- Ensure that the various samples are collected by the same operator.
- Start the test 2-3 weeks before the tentative harvest date to monitor the maturity of fruit.

The “Colour Code” is an indispensable tool to ensure an optimum quality of harvest



TOOLS TO ASSESS THE STAGE OF MATURITY OF FRUIT

Table 6: Optimal stages and tools to assess maturity

Criteria	Optimal stages	Tools
Intensity and percentage of pink colour	Stages R4-R5	Colour code Ctifl / Star Fruits® / Association Pink Lady® Europe
Background colour	Stages F3-F4	
Decrease in starch content	Stages 4 to 5	Starch decrease code Ctifl Scale 1 to 10
Firmness	8 to 7 kg/cm²	Penetrometer

Figure 7:
Annual monitoring
of firmness –
South-east France network



■ Harvest period

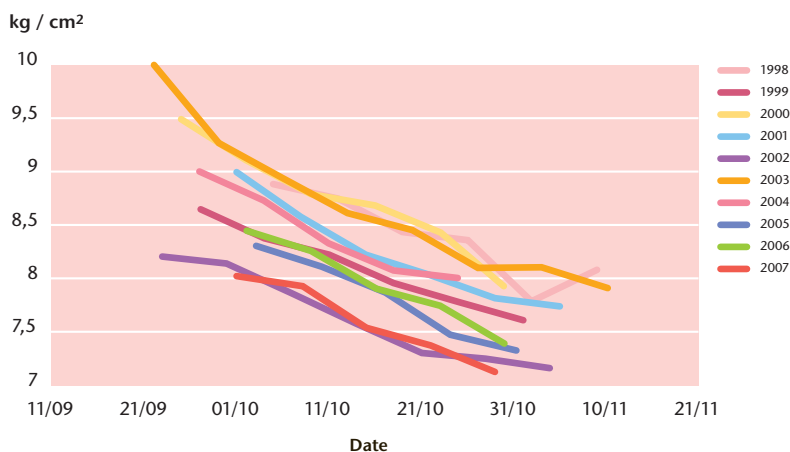
Deciding the harvest end date is one of the tools of Pink Lady® Europe Association's quality policy.

Each year, depending upon the weather conditions, grower organisations, packing houses or apple marketers must decide a deadline by which the batches must be in the cold store. Failing which, the date is decided by the Association. Apples harvested after this date cannot be marketed under the Pink Lady® brand.

■ Objectives and implementation of maturity network

Networks monitoring the maturity of apples are set up in several production areas. They aim at providing growers with information on the maturity of apples and determining the optimal harvest date to ensure high-quality fruit with good storage capacity. Weekly reports are sent to technicians and growers who are part of this network. Harvest start dates can thus be suggested for each geographical zone with adaptation depending on the orchard type. Annual comparisons are extremely useful in determining your orchard standing, planning the development of a parameter and the need to speed up harvest should signs indicating quality loss be present (see figure 7).

The Pink Lady® European maturity network summarises data from the various local maturity networks in Europe. This information is sent by the Pink Lady® Europe Association to the participants of each of the local networks.



■ Perspectives

The Rosy Glow_{COV} mutant has the special feature of developing its pink colour at an earlier stage than Cripps Pink_{COV}. This feature enables the **right colour and physiological maturity to be attained at the same time, thus avoiding the risk of over-ripeness**. However, care must be taken to not go to the opposite extreme by harvesting Rosy Glow_{COV} fruit that are immature and poor in taste.

This point is illustrated by table 7 that shows that on 09/10/2006 Cripps Pink_{COV} and Rosy Glow_{COV} had reached the required minimum starch content (4 - 5) but only the Rosy Glow_{COV} fruit had the required colour intensity (R4-R5). As a result it was possible to start harvest in the Rosy Glow_{COV} orchard as of 09/10, whereas in the case of Cripps Pink_{COV}, the harvest could not be started until 25/10.

Table 7: Harvest 2006 – Tree in 5th leaf – Ctifl Balandran

	Colour surface		Pink colour Code		Starch	
	%		1 - 8		1 - 10	
	Cripps Pink _{COV}	Rosy Glow _{COV}	Cripps Pink _{COV}	Rosy Glow _{COV}	Cripps Pink _{COV}	Rosy Glow _{COV}
2006						
02/10	41	83	0,9	2,1	3,2	3,4
09/10	51	92	1,5	5,9	4,3	5,2
15/10	62	98	2,0	5,7	5,2	6,7
25/10	77	92	4,3	5,0	7,2	7,6



■ Testimonial

Harvest operations need to be planned well beforehand in order to comply with the optimum maturity period. A good organisational set up is indispensable to avoid ending up with over-ripe fruit and harvest operations from stretching on endlessly.

Christophe Roduit, apple grower in Manosque – Alpes de Haute Provence – South East France shares his views on the organisation of harvest activities and size of teams.

In this 20 hectare Pink Lady® orchard in full swing (production of about 65 tonnes / hectare), the overall volume of Cripps Pink_{COV} and Rosy Glow_{COV} to harvest is 1,300 tonnes.

Since the fruit continues to mature, this tonnage must be harvested over a five week period (keeping a safety margin of one week).

The first week of getting started is always hard and involves:
– learning again to carefully harvest (orchard quality control mandatory)
– readapting to colour
The yield of fruit pickers is low in the first round of harvest.

Calculating the size of harvest teams for this activity is as follows (table 8).
In the end, over 50 fruit pickers are required for harvesting Cripps Pink_{COV}. Teams corresponding to this labour requirement can only be set up if planned well in advance.

Table 8: Size of harvest team

Round	% of volume	Tonnage to harvest	Yield (kg/h)	Harvest days (8 h)	Tonnage per person	No. of persons
First	25	325	100	8	6,4	51
Second	40	520	125	10	10,0	52
Third	35	455	150	7	8,4	54
TOTAL	100	1 300		25		52

Chapter 7

Storage

Storage is the ultimate stage before the fruit is marketed. The obtained fruit quality that depends on the harvest must be preserved for several months. Adapted storage conditions are required to preserve the exceptional potential of the Cripps Pink_{cov} variety and market the fruit under the Pink Lady® label. The stakes are high and the storage techniques used must take into account the non-uniform nature of the orchard, as well as the potential differences in the stages of maturity. These factors are decisive in guaranteeing customer satisfaction.



Controls
on the grading line
in order to limit impacts



Characteristics of the variety

- Storage capacity : good in controlled atmosphere, very good in ULO (Ultra Low Oxygen)
- Sensitive to low temperatures and excess CO₂
- Sensitive to impacts! Handle with care
- Loss of quality possible during storage:
 - fruits becoming greasy (not tolerated by the Pink Lady® brand),
 - loss of firmness (minimum to be maintained: 6kg/cm²).
- Specific sensitiveness:
 - superficial scald,
 - flesh browning,
 - lenticel rot.





Key points for storage without problems

Orient batches according to their storage potential

Ensure good storage conditions

Comply with basic storage guidelines:

- do not store at very low temperatures,
- ensure that CO₂ concentration stays below 1.5 %.

Manage post-harvest treatments

**Adapt storage conditions and duration to the main risk:
quality loss or flesh browning**

Avoid storing for extended periods fruit that are:

- too ripe (late harvest),
- coming from young or imbalanced orchards.

**Avoid temperature or controlled atmosphere (O₂ or CO₂ levels)
drifts over time.**





Superficial scald



Stalk-end scald



Lenticel rot

■ Improve storage management

Orient batches according to their potential

Long-term storage: Fruit harvested at a less advanced stage of maturity from balanced orchards (*Ctfl* codes: *starch* 4-6 and *background colour* F3-4).

Priority destocking: Fruit harvested at an advanced stage of maturity (*starch* > 6-7, *background colour* F 5-6).

Short-term storage: Batches from young orchards or orchards with a light crop load.

The storage period will depend on the sales target, the market, and especially **on the stage of maturity of the harvested fruit** to reduce the risks.

Premature harvest:

- superficial scald

Late harvest (if weather conditions are less conducive to obtaining a good colour):

- over-ripeness: fruit cannot be stored for a long time, low quality of texture, less juicy and greasy skin,
- high sensitivity to flesh browning,
- lenticel rot and phytophthora especially in rainy conditions,
- special sensitivity to stalk-end scald.

It is important to monitor the development of fruit in the packing house: regularly sample fruit (once a month) to assess development in cold store and subsequently at room temperature (7 days) **to set destocking priorities!**

Manage post-harvest treatment...

according to the objectives, storage conditions (storage duration greater than 2-3 months in controlled atmosphere CA) **and maturity stage.**

The use of the following active substances is possible **provided that they are registered** in the concerned country and the conditions of use and dosage are respected:

Diphenylamine against superficial scald.

Thiabendazole against lenticel rot:

application by immersion, showering or thermo-fogging (directly in the cold store as a fog).

1-MCP action against superficial scald and on controlling maturity:

- applied as a gas in the cold store,
- 1-MCP inhibits the action of ethylene, preventing scald and maintaining fruit quality in terms of firmness, acidity, background colour and greasy appearance,
- practical comment: It is important to bear in mind the size of the cold store! In fact, the product must be applied within seven days following harvest. Therefore, it is necessary to select a cold store that can be filled within this time frame depending on the capacity of the packing house,
- applying the product after 7 days is ineffective especially in controlling superficial scald.

For further information on registration, dosage and recommendations consult:

- *your technical department,*
- *the concerned companies,*
- *official websites.*





Three types of flesh browning:
Diffuse



Radial



CO₂ injury

Flesh browning

This problem may appear during long-term storage (from mid-February in normal cold season and mid-march in controlled atmosphere), and is due to a complex combination of factors. **The appearance of this defect is sporadic, hard to foresee and very variable depending on the annual seasonal climate and sometimes it may be severe.**

This physiological disorder affects the two clones (Cripps Pink_{cov} and Rosy Glow_{cov}). Rosy Glow_{cov} is considered to be more sensitive given the current state of knowledge.

Table 9: Factors increasing the risk of flesh browning

Before harvest

- Late harvest related to over-ripeness
- Young orchard (< 4th leaf)
- Light crop load in comparison to the orchard's potential
- Poor balance of the tree
- Influence of the weather conditions of the year

During and after storage

- Excessively long storage (5-6 months depending on storage conditions)
- Low storage temperature: 0-1 °C
- High CO₂ level especially if O₂ level very low

Note that flesh browning becomes severe after return to room temperature



Figure 8: Observation of flesh browning under different storage conditions
(Trials Ctifl – CEFEL – La Morinière 2001 à 2005)

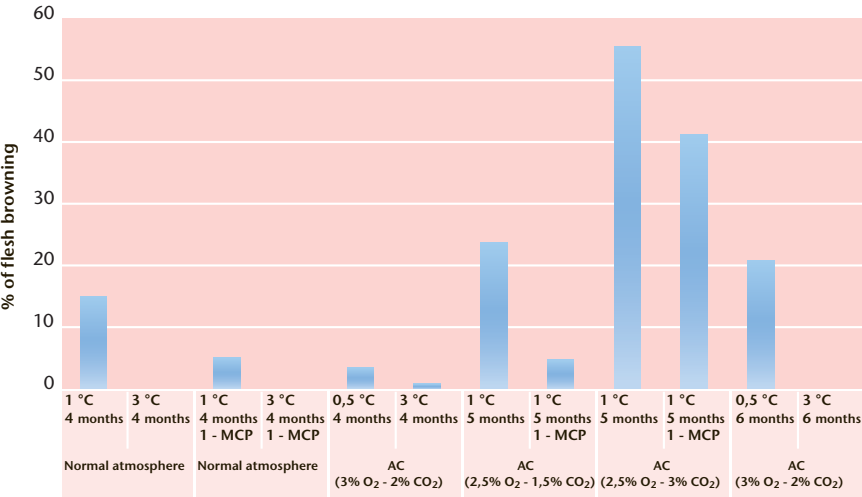


Table 10: Storage conditions and management of sales

Release date	Temp. °C	Atmosphere	Risks
January	1-2 °C	Normal	Loss of quality (firmness, greasy appearance, yellow background colour, etc.)
March-April	1,5-2,5 °C	Controlled 2-3 % O ₂ ; 1-1,5 % CO ₂	Superficial scald, Stalk-end scald, Flesh browning, Lenticel rot
After April	1,5-2,5 °C	Controlled 1,5-1,8 % O ₂ ; < 1 % CO ₂	



■ Few tips to follow...

Dynamic controlled atmosphere (DCA)

PRINCIPLE

Store fruit in extreme, dynamically adapted ULO (Ultra Low Oxygen) conditions within limits acceptable by the fruit.

APPLICATION

After creating the controlled atmospheric conditions, the oxygen level is reduced and the fruit sample is monitored by chlorophyll fluorescence sensors (6 sensors on 6 different batches for a 300-tonne storage room). After cooling to the recommended temperature, the oxygen level in the room is brought down to less than 0.7% in a week until a stress peak is recorded by the fluorescence sensors.

When the fruit are in anaerobic conditions, their skin emits a stress signal detected by fluorescence sensors. The oxygen level is then increased to about 0.2% to avoid fermentation. This stress peak depends on the fruit variety and maturity stage.

For some varieties, the oxygen level may be significantly decreased without any risk to fruit at a less advanced stage of maturity (0.4%). Whereas mature fruit require levels close to 1%. Additional experiments are required to explain the behaviour of Cripps Pink_{cov} under these conditions.

TWO-FOLD OBJECTIVE

Improve storage by gradually slowing down respiration and controlling superficial scald without post-harvest treatment.

CONSTRAINTS:

- uniformity of fruit in the storage room with six representative samples,
- storage room with a maximum capacity of 300 tonnes. Beyond this limit, it is hard to fill the room with fruit having the same maturity and to cool them properly. Filling time: 5-6 days maximum,
- air-tight rooms with specific equipment capable of maintaining very low levels of O₂ and CO₂.

Stage-wise decrease in temperature

Increasing the storage temperature ($>2-3^{\circ}\text{C}$) reduces the risk of flesh browning but leads to other problems (loss of quality, greasy appearance).

One solution could be to gradually decreasing the temperature in stages.

The Laimburg experimental centre in Italy (South Tyrol) tested various cooling pathways to reduce flesh browning.

The following pathway is retained:

- 4°C when filling the cold store (for about 7 days),
- gradual decrease in temperature to 2.5°C (for 15 days),
- lastly, closing the cold store and creating controlled atmosphere ($1.8\% \text{O}_2$; $<1.3\% \text{CO}_2$).



■ Testimonial

Georges Fandos manages the orientation of batches and storage of Cripps Pink_{COV} at the Cofruid'Oc packing house in (Saint Just – Hérault – South-East France).

To ensure optimum storage conditions and market high-quality fruit, the packing house has implemented a precise monitoring procedure based on the following five points:

1 - Prior requirement: traceability back to the plot (from the orchard to the packing house) and during storage.

2 - Information on the entire orchard and plantation dates. The yield from young orchards will be stored for short periods to avoid flesh browning and ensure uniform level of maturity in the batch.

3 - Information on fruit load of trees (potential yield, size) to minimise risks of bitter pit and imbalanced fruit. Orchards showing bi-annual bearing, with low fruit load, suffering from chlorosis or under water stress are identified by the technical expert.

4 - Information on specific problems resulting from unfavourable weather conditions: frost, hail, floods, etc. The fruit are more fragile and will be stored for shorted duration.

5 - The maturity stage of fruit in the orchards through the maturity networks (reference plots) or pre-harvest analysis on the starch level, firmness, sugar level and acidity.

Fruit picking at the right date ensures optimum fruit quality in terms of aroma, firmness, crispiness and flesh structure. It also minimises risks linked to premature harvest such as scalds and bitter pit or late harvest such as greasy fruit and flesh browning.

Moreover, fruit from late harvest are more sensitive to bruises.



Depending on the criteria, the stored batches are divided into two categories:

Short-term storage batch

- Young orchards (less than 3 years old)
- Orchards with light crop load (bi-annual bearing, frost, chlorosis)
- Orchards impacted by severe weather conditions
- Non-uniform first round from the maturity point of view
- Third/fourth harvest round (over-ripe fruit, poor colour, greasy)

Long-term storage batch

- Balanced adult orchards from the crop load point of view
- First round when uniform maturity is attained
- Second harvest round (fruit batch generally more uniform from a maturity point of view).

The technical expert classifies each plot according to the criteria and informs the head of the packing house before harvest.

Upon entry into the station, the batches are **identified and stored in different cold stores** that will be opened in the order of this classification.

A **rigorous and systematic** classification such as the one put in place by Cofruid'Oc is **indispensable** to provide consumers with high-quality fruit.





FOR FURTHER INFORMATION...

USEFUL ADDRESSES

PINK LADY® Europe Association

436, avenue Charles de Gaulle

84100 ORANGE

Telephone 33 (0)4 90 11 91 80

Fax 33 (0)4 32 81 13 31

Mail : contact@pinklady-europe.com

Web : www.pinklady-europe.com

STAR FRUITS®

Route d'Orange

84860 CADEROUSSE

Telephone 33 (0)4 90 11 93 50

Fax 33 (0)4 90 11 93 51

Mail : contact@star-fruits.com

Web : <http://www.star-fruits.com>

Ctifl

Ctifl - Siège

22, Rue Bergère - 75009 PARIS

Telephone 33 (0)1 47 70 16 93

Fax 33 (0)1 42 46 21 13

Mail : info@ctifl.fr

Web : www.ctifl.fr

Web : www.fruits-et-legumes.net

Ctifl - Centre de Lanxade

B.P. 21 - 24130 LA FORCE

Telephone 33 (0)5 53 58 00 05

Fax 33 (0)5 53 58 17 42

Ctifl - Centre de Balandran

B.P. 32 - 30127 BELLEGARDE

Telephone 33 (0)4 66 01 10 54

Fax 33 (0)4 66 01 62 28

Ctifl - Centre de technologie de Saint-Rémy-de-Provence

Route de Mollégès

13120 ST REMY DE PROVENCE

Telephone 33 (0)4 90 92 05 82

Fax 33 (0)4 90 92 48 87



Regional experimentation centres - France

CEHM

Mas de carrière
34 590 MARSILLARGUES - France
Telephone 33 (0)4 67 71 55 00
Fax 33 (0)4 67 71 09 11
Mail: info@cehm.net
Web: www.cehm.net

Station d'Études et d'Expérimentations fruitières Nord-Loire

La Morinière
37800 ST EPAIN - France
Telephone 33 (0)2 47 73 75 00
Fax 33 (0)2 47 73 75 08
Mail: la.moriniere@wanadoo.fr

CIREA

Franchemont
24130 PRIGONRIEUX - France
Telephone 33 (0)5 53 73 07 32
Fax 33 (0)5 53 61 66 45
Mail: cirea-franchemont@wanadoo.fr

CEFEL

Domaine de Capou
49, chemin des Rives
82000 MONTAUBAN - France
Telephone 33 (0)5 63 03 71 77
Fax 33 (0)5 63 66 57 22
Mail: cefel@aliceadsl.fr

LA PUGÈRE

Chemin de la Barque
13370 MALLEMORT - France
Telephone 33 (0)4 90 59 29 00
Fax 33 (0)4 90 59 23 23
Mail: contact@lapugere.com
Web: www.lapugere.com

Experimentation and research centres - Italy

CRIOF - Centro per la Protezione e Conservazione dei Prodotti Ortofrutticoli

Università di Bologna
Via Gandolfi 19
40057 GRANAROLO Emilia (BO) - Italia
Telephone 39 (0)51 76 65 63
Fax 39 (0)51 76 50 49
Mail: bibcriof@agrsci.unibo.it
Web: www.diproval.unibo.it

Research Centre for Agriculture & Forestry Laimburg South-Tyrol

Pfattnerstrasse. 3
39040 ORA - Italia
Telephone 39 (0)471 969 691
Fax 39 (0)471 969 599
Web: www.laimburg.it

Experimentation and research centres - Spain

IRTA - Estació Experimental de l'Ebre
Ctra. Balada, Km 1
43870 AMPOSTA (Tarragona) - España
Telephone 34 (0)977 26 70 26
Fax 34 (0)977 26 70 25

IRTA
Av. Alcalde Rovira Roure, 177
25198 LLEIDA - España
Telephone 34 (0)973 70 25 79
Fax 34 (0)973 23 83 01
<http://www.irta.es>

This manual is published in 4 languages
and 3 250 copies have been printed including:

Pink Lady®: les points clés in 1 500 copies

Pink Lady®: key points in 450 copies

Pink Lady®: los puntos clave in 500 copies

Pink Lady®: i punti essenziali in 800 copies

Fabrication

Traduction

Conception graphique et mise en pages

Illustrations

Photogravure

Achevé d'imprimer

Jean Granier, Ctifl

Office Européen de Communication

Catherine Combier

Bernard Mathieu

Philippe Bauducel

Alinéa Print

Pink Lady®: key points

Pink Lady® owes its success not only to the marketing approach adopted but also to the inherent qualities of the apple: attractive, crisp, juicy and fragrant. Cripps Pink_{cov} has also a rather unique colour making it easy for people to identify the fruit.

All of these characteristics are mentioned and catalogued in a specifications guide. Complying with these specifications assures a uniform quality of Pink Lady® apples which are ranked as a premium product in the market.

The entire network is thus organised with a view to attain this quality objective and ensure customer satisfaction.



PINK LADY® Europe Association

436, avenue Charles de Gaulle

84100 ORANGE - France

Telephone 33 (0)4 90 11 91 80

Fax 33 (0)4 32 81 13 31

Mail : contact@pinklady-europe.com

Web : www.pinklady-europe.com



star fruits®

STAR FRUITS®

Route d'Orange

84860 CADEROUSSE - France

Telephone 33 (0)4 90 11 93 50

Fax 33 (0)4 90 11 93 51

Mail : contact@star-fruits.com

Web : <http://www.star-fruits.com>

Ctifl



Centre technique interprofessionnel des fruits et légumes

22, Rue Bergère - 75009 PARIS - France

Telephone 33 (0)1 47 70 16 93

Fax 33 (0)1 42 46 21 13

Mail : info@ctifl.fr

Web : www.ctifl.fr

Web : www.fruits-et-legumes.net



Price: 18,00 € TTC