

THE SOUTH AFRICAN PINK LADY® HANDBOOK

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Original handbook compiled in 1997 by: *Jeanne Fourie – TopFruit*
With inputs from: *Piet Nieuwoudt, Louis Giliomee, Keith Fuller- CFG*
Chris Jurisch - Kromco; Buks Nel – Two-a-Day
Jaco Moelich - Hortec; Bennie Smidt - Unifruco
Desmond Mudge - Chiltern Farms
Bernhard Treptow – Consultant

Revised (December 2002) by: Richard Hurndall – Deciduous Fruit Producers' Trust

With contributions from:

Peter Alderman – TopFruit
Chris Jurisch – Arbor Tech
Frikkie van Schalkwyk - Kromco
Niel du Toit, Buks Nel, Anne-Marie Green – Two-a-Day
Prof Karen Theron – Horticulture, University of Stellenbosch
Kobus van der Merwe – ARC Infruitec-Nietvoorbij
Tienie du Preez - Consultant
Phil Kilpin - SAPLA
Peter Dall – SAPLA
Dr Jim Button - TopFruit
John Stone - Hortec

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A. FOREWORD

Both the unique appearance and superb eating quality of Pink Lady® apples provide growers and traders the opportunity of differentiating this superior product from the mass of commodity apples. The Pink Lady® trademark with the “flowing heart logo” distinguishes these apples as a product in its own right. Although fruit of Cripps’ Pink are good eating, it is the guarantee associated with the Pink Lady® trademark that earns the premiums. The trademark guarantees consistent superior quality regardless of where the fruit is produced.

A trademark user fee is levied on all products marketed using the mark. The user fee is spent on ensuring that quality is not compromised and in protecting the brand. There is a separate levy imposed that is spent solely on promoting the branded product.

The establishment of the International Pink Lady Alliance Ltd (IPLA) has been a major step in fostering co-operation and co-ordination in production, distribution, and marketing of the product. Increased support over the past year from all corners of the globe has added greatly to the confidence and optimism that both growers and traders have in the brand. This support has also manifested itself in even greater premiums paid for the Pink Lady® branded product over very good quality Cripps’ Pink apples. South African producers are represented on the IPLA by Peter Dall, who is Chairman (also Chairman of SA Pink Lady Association - SAPLA), and Dr Jim Button (TopFruit), who is managing the Alliance.

Objectives of SAPLA

- To promote the Pink Lady® trademark.
- To establish uniform grading regulations for the trademark and endeavor to ensure that international uniform regulations are drawn up and applied worldwide.
- To liaise with other Pink Lady groups in the world and to form an international Pink Lady® network.
- To advise and assist the master licensee to exercise the powers granted to the master licensee, to best advantage of the various stakeholders.
- To look at ways of promoting sales and consumption of Pink Lady® on the local market and persuading the retail trade to assist in promoting the trademark.
- To facilitate research into the growing, packing, storing and marketing of Pink Lady®.
- To disseminate knowledge regarding production, packing and marketing aspects of Pink Lady®.
- To ensure a well co-ordinated and purposeful corps of producers, packers and marketers of Pink Lady®.

The **Pink Lady® levy allocation** (US cents) per 13 kg carton is as follows:

SAPLA	2,0
Topfruit	10,0
Promotion	65,0
APAL (Admin/quality audit)	20,0
Defence	10,0
Total	107,0

These costs must be seen in the light of premiums obtained by Pink Lady® over Cripps’ Pink.

Production of high yields of Pink Lady® quality fruit is challenging, especially in areas where sunburn is a general problem. Special care is required to pack and transport this product successfully, and post-harvest expertise is critical for any long-term storage programmes.

This handbook has been brought up to date through contributions of experts, calling on years of local experience, and co-ordinated by Richard Hurndall of the Deciduous Producers Trust. Together with the colour charts produced by TopFruit and SAPLA, this handbook will be invaluable to all Pink Lady® growers.

Dr Jim Button
Manager IPLA

2.1 THE TREE

2.1.1 Rootstocks

Semi-dwarfing rootstocks have been recommended for this vigorous variety. However, very few plantings have been made on weaker rootstocks, partly because many of the Pink Lady® orchards are on replant soil. Most of our plantings are on M793 and M25. The more vigorous the rootstock, the more challenges we can expect in achieving fruit of good colour and quality.

MMI06 is proving to be a good rootstock for Pink Lady® on sites where *Phytophthora* is not a problem. Trees have wide angled branches and are very productive. M7 might also be a good choice, but we are still getting to know this rootstock. M25 seems to be a well balanced tree as early cropping limits vigorous growth. Local laboratory and greenhouse experiments to assess relative resistance of commercial rootstocks to *Phytophthora* show that M25 has an intermediate susceptibility, and planting sites should be selected with care. M793 is vigorous and upright, but is known by most producers and can possibly be used in replant sites. One seasons' data (not statistical), from a site where harvest maturity of three rootstocks was evaluated, showed that fruit of M793 matured before M109, which in turn was more advanced than M25.

A potential problem might occur where vigorous rootstocks have been planted in very narrow spacings. The Australians have in the past generally planted their trees with wide spacings, but are now planting at a distance of 4.5 x 1.5 m. Some people advise that we plant trees at 4.5 x 2 m on vigorous rootstocks and good soils and 4 x 1.5 m on average soils. The relationship between **soil potential, rootstock and planting distance** is very important. Take care of overshadowing of lower branches or adjacent trees. Pay close attention to vigour and training for all plantings, irrespective of spacing. For optimum light interception it is important to have rows orientated **north - south**. Where rows have not been planted north-south, extra input should be made to ensure that these fruit get enough direct sunlight. In Elgin, many producers have chosen to plant on southern slopes for protection against the wind (less risk of fruit drop), less sunburn and better colour. However, trees planted on north facing slopes seem to have better colour development, but more sunburn. The effect of slopes on colour development and sunburn is still being investigated. In the meantime, it is recommended that sites with lower autumn temperatures be selected for new plantings. Whatever rootstock and spacing or plant density is used, it is important to have an open tree, which is **light friendly** and manageable.

2.1.2 Growth habit

Pink Lady® has a **vigorous and upright growth habit with basal dominance**. Do not head the trees at planting as this accentuates basal dominance. Remove vigorous upright shoots during early summer to prevent overshadowing of lower fruit. Too much vegetative growth will lead to fewer spurs forming, lower yield, overshadowing of fruit and poor fruit quality. Fruit set terminally will encourage spur growth, which will create more fruiting sites, thereby developing a more productive unit. If left unpruned, many laterals will develop, of which the basal ones are not the strongest.

2.1.3 Training

The Australian Model consists of a strong basal tier (75-100 mm from soil level) with a second tier 1 m above the first in wide spaced orchards (4,5 x 2 to 5 x 2 etc.). The space between the tiers does not contain strong shoots and allows light penetration. Their aim is to bear 75% of the crop on the basal tier, which is easily manageable. The second tier should not exceed 66% of the area of the basal one.

Our models consist mainly of central leader trees, and depending on the planting distance, a basal tier can be developed. On the wider spacings (> 2m between trees) a second tier can be developed above the first. On the narrower spacings (< 2m between trees) a weak basal tier can be developed with informal fruiting wood above it. Start lower bearing units at 80 cm above ground. A window of 50 - 60 cm above the tier or production table should be clean of branches before starting the fruiting wall. Some people consider the idea of a wall or palmette as with bi-coloured pears. Others prefer a 'round'

tree comprising a central leader upon which the bearing units are well spaced. The tree has a pyramidal shape and all bearing units are subordinate to the main central leader.

The use of a support system is strongly recommended. It is particularly important to support dwarfing rootstocks. A support system is essential where newly planted trees are left untopped in a high density planting.

Whatever training system is used, it is important to create an **open tree** that will allow **maximum light distribution** in the canopy. Remove vigorous shoots that may overshadow fruit in the lower parts of the tree. This will ensure that fruit buds are formed along the limbs and a large percentage of well coloured fruit be produced.

Training is especially important in the **first 3 years** for the proper shaping of the trees. It is important to manage laterals not to exceed the 3:1 ratio. Laterals should be bent down in early summer, because the wood hardens quickly. Select shoots with a wider angle and limit pruning cuts that encourage vigorous regrowth. Very little winter pruning should be done in the first 3 years. Continue bending shoots during summer. Structural wood should be removed between harvest and leaf fall, but can also be removed successfully during December, when the regrowth potential is low. Summer pruning, nitrogen management, irrigation and early cropping can assist in developing reproductive, balanced trees.

Winter pruning on bearing trees involves renewal of bearing wood. Excessive winter pruning results in vigorous regrowth. Overshadowing will decrease the fruit producing capacity of the tree. In Australia, most of the pruning on mature trees is done in summer while winter work is limited to a minimum. In large, dense trees a dark core can develop on the inside of the tree where fruit will not receive enough light to be well coloured.

Allow first fruit to set even though they will be of a poor quality, because they will assist in tree manipulation (bending shoots down and controlling vigour by making the tree reproductive). Remove fruit on young leaders, especially the terminal bud, to allow the leader to grow.

In many orchards the central leader has runted out because the necessary summer work to control shoot growth in the basal parts of the trees was not done timeously, or at all.

There are significant numbers of grafted trees in the industry. These trees grow very vigorously, most often upright. Trees should be trained at an early stage to develop an open tree shape and to allow light penetration. Manipulate lateral shoots in December (bending flat) to slow growth. It would be good to set fruit as soon as possible to settle the tree in a reproductive phase. Grafted trees with high nitrogen levels will result in poor fruit quality, insufficient colour and also low firmness.

2.1.4 Fertilisation

The challenge of growing Pink Lady® is to establish orchards which give the right balance between early bearing on the one hand, and regular high tonnage of well coloured fruit with a low incidence of sunburn in the full bearing phase on the other. Although light interception/distribution and orchard temperature are the most important factors influencing blushed colour, there is enough evidence to suggest that colour development can also be influenced by tree nutrition. It should be remembered, however, that there is often a trade-off between optimising one quality parameter and adversely affecting another. The Australian recommendation **during the first three years** of tree growth is to maintain luxury levels of nutrition to achieve maximum tree development. With the **onset of cropping**, nutrition should be managed in such a way as to enhance fruit quality.

According to the Australians, **Pink Lady® is not a nitrogen-friendly variety; nitrogen (N) levels should be kept low.** While there are exceptions, Pink Lady® is usually only vigorous under our circumstances when topworked. In young orchards we are tempted to give too much nitrogen in order to make the tree grow quickly and fill its space. Excessive amounts of nitrogen are very dangerous in the production of Pink Lady® fruit. Nitrogen promotes vegetative shoot growth, long internodes and

fewer spurs. Long shoots shade fruit, leading to poor fruit colour. Fruit tend to have a greener background colour and the pink blush appears muddy. Fruit quality is also negatively affected by too much nitrogen, having lower levels of TSS, lower firmness and fruit with an uneven hammered finish. Apply normal nitrogen fertiliser in early spring to bearing trees. Monitor leaf colour regularly. Fruit on trees with a very pale leaf colour will develop less pink colour than fruit of normal green trees. If the leaf colour is still too pale green by January, due to too low leaf nitrogen, apply 1 or 2 urea sprays at 500g/100 litres for proper bud development. Do not apply nitrogen to the soil at this late stage unless there really is a nitrogen deficiency. A too dark a leaf colour is not desirable. Aim for the following nitrogen levels in the end-January leaf analyses:

Vigorous young trees with light crop	2,2 – 2,6% N
Mature trees with normal vigour	2,2 – 2,4% N

Calcium (Ca) will improve the keeping quality of the fruit. Leaf calcium levels should be maintained above 1,5%. Pink Lady® is not especially prone to bitter pit. A spray programme of five to six sprays (4x $\text{Ca}(\text{NO}_3)_2$ followed by 2 x CaCl_2 plus Kelpak) can be followed to increase the storage potential of the fruit. (According to Tienie du Preez, early sprays are known to be inefficient; rather start end-November in SA).

According to literature, Pink Lady® is susceptible to **magnesium** (Mg) deficiency and should be sprayed if symptoms are diagnosed or the magnesium levels are lower than 0,25% in the leaves. Magnesium deficiency, an inherited characteristic from Lady Williams, is exacerbated by high **potassium** (K), and care should be exercised to keep potassium levels at around 1,5% in the leaves (Australian literature). Where the pH in the soil is too high, sprays are not necessary if the Ca : Mg ratio of the soil is balanced with calcitic and dolomitic lime, or Agmag.

A high level of **phosphorus** (P) in the tree is essential for the production of high quality fruit, and for the satisfactory growth and cropping of the tree. High levels of phosphorus increase fruit set and prevent stunting of the trees. The effects of phosphorus on fruit quality, besides enhancing colouring potential, include an increase in cell wall thickness and thus enhanced fruit crispness, a slowing of the respiration rate which results in long storage and shelf-life, and an increase in sugar levels, giving greater eating quality.

Potassium and phosphorus levels should be optimised pre-harvest. Follow a normal potassium and phosphorus fertilisation programme, and adjust on the basis of results of soil and leaf analyses, and crop size. Apply potassium sprays with a soft product that does not contain any nitrogen, in November or March (before and after bitter pit) sprays.

Some additional aspects to consider are as follows:

Keep the nitrogen, magnesium and manganese levels relatively low in the pre-harvest part of the season (Jan-March).

Reduce spring nitrogen application rates substantially (if not completely) and apply a few target urea sprays very early in the season (budbreak - 100% petal drop).

Apply slightly higher nitrogen rates post-harvest (if leaf conditions allow), possibly in combination with urea sprays.

Apply only the minimum number of calcium sprays necessary for satisfactory control of bitter pit. Avoid excessive use of calcium nitrate.

Look at the liming programme and ensure the correct Ca:Mg:K balance in the soil.

Avoid spraying manganese-containing foliar feed and fungicide products unless absolutely necessary. If a manganese deficiency is anticipated, spray Mancozeb early in the season or manganese sulphate by the end of November at 100 g/100 litre or before budbreak at 1000 g/100 litre. High manganese

levels in the fruit skin may result in greener ground colour at harvest, and impair the production of anthocyanins. Apple scab (*fusicladium*) needs to be well controlled in the early part of the season to prevent having to spray excessive protective fungicides containing Mancozeb later in the season.

Table 1. Leaf nutrient levels advised in Australian literature (late January/early February):

Nutrient	Optimum Leaf Concentration	Comment
Nitrogen	2,0%	Higher nitrogen levels will encourage non-productive vigorous growth.
Calcium	1,5-2,0 %	Adequate calcium levels in leaves and fruits are necessary for maintaining quality.
Magnesium	0,26-0,4 %	Cripps' Pink is susceptible to magnesium deficiency.
Phosphorus	0,18-0,20 %	Phosphorus is essential for fruit quality and fruit set.
Potassium	1,2 –1,5 %	Potassium is essential for fruit size. High levels may induce magnesium deficiency and lower uptake of calcium.
Zinc	20-50 ppm	Zinc deficiency causes stunting or die back of limbs.
Boron	21-40 ppm	Boron deficiency causes cracking in fruit.
Copper	6-20 ppm	Copper deficiency causes tip die-back in young trees.
Manganese	50-80 ppm	Manganese is essential for the production of chlorophyll needed in photosynthesis.

2.1.5 Chilling requirements and chemical rest-breaking

According to Du Toit (1995), Pink Lady® has a medium chilling requirement, which makes it suitable for planting under a wide range of climatic conditions in South Africa. In the colder growing areas (Ceres/Koue Bokkeveld), chemical rest-breaking sprays are seldom necessary on bearing trees. In the warmer areas, depending on the chilling units accumulated and orchard location, the combination spray of 0,5% Dormex + 2% Mineral Oil, or Mineral Oil on its own at a concentration of 4 - 5% should give adequate rest breaking in most years. The timing of the rest breaking spray is in line with the spray date of the other cultivars (last week of August to first week of September). The Dormex + Oil combination is also a handy tool to promote adequate vegetative breaks on non-bearing Pink Lady® trees, as well as help to synchronise the blossoming periods of Pink Lady® and its polliniser, when planted in separate rows.

2.2 THE FRUIT

2.2.1 Effect of tree age on fruit quality

The age of the trees has a strong effect on fruit quality. Young trees tend to produce fruit with a hammered fruit surface, especially on vigorous rootstocks or topworked trees and with liberal supply of nitrogen. Fruit background colour of young trees is greener than fruit of mature trees, and the pink blush appears muddy. The green colour can mislead producers to delay harvesting, resulting in the development of greasiness and a shortened storage and marketing period. Fruit may also have a red/brown blotched surface.

It is not to our advantage to export fruit of a lower quality standard. As a guideline, only consider using the Pink Lady® brand for export once production has exceeded 5 t/ha. Marketers should manage the distribution of fruit from trees of different ages to prevent inferior quality being marketed. Fruit quality and appearance improves with tree age. The crop of older trees is harvested earlier.

2.2.2 Colour development

The market requirement is for fruit with a **pink blush** on a lime-green background. A full-coloured fruit is not required. The pink is distinguishable from red, and light to bright pink is preferable. **There are no regulations for fruit being too red.** We should however concentrate on getting sufficient pink-coloured surface area (40%).

The colour is not an indication of maturity. The pink colour develops late in the season with the onset of ripening, and is a result of direct sunlight that the fruit was exposed to during the development, and low night temperatures. The importance of **direct sunlight** for the development of fruit colour cannot be emphasised enough. Where fruit is shaded by leaves or branches, colour development does not occur.

Summer pruning is an important tool in the management of these trees. If summer work is done throughout the season to eliminate strong upright shoots, the trees would be more light friendly. Strong verticals can compete with the leader and shade lower fruit, leading to poor colour. To increase colour on the fruit, a final summer pruning or stripping leaves of shoots just above the fruit for pink colour improvement can be done 2-3 weeks before harvest. Turning the fruit has been observed to improve colour development after a few days.

Sunburn is a major defect of Pink Lady®. Care should be taken to prevent sunburn and not to overdo summer pruning. Some advisors concentrate on colour development and keep the trees open through the season and sacrifice a few fruit to sunburn. Summer pruning within two weeks from harvest can lead to sunburn. Irrigation should also be managed well, so that water stress during the hottest part of the day would not enhance sunburn on the fruit. Local experience has connected sunburn to pruning during the hottest months (mid-Dec to mid-Jan). Pruning done early and late in the season carries a lesser risk of sunburn.

Evaporative cooling has to date not been shown statistically to improve colour, but does improve fruit size and reduce sunburn.

2.2.3 Pollination

In Australia, Red Delicious, Fuji, Royal Gala, Granny Smith, Splendour and the ornamental Malus Evereste have been described as pollinisers. Good pollination is necessary for good fruit size and quality. In the absence of sufficient pollination, deformed fruit are noticed, especially in young orchards. Generally, Granny Smith is regarded locally as a good polliniser and is easy to manage, it also being a late maturing variety. In Elgin, Braeburn and Sundowner are much earlier than Pink Lady®. In Ceres, these varieties are a few days earlier and might be suitable as pollinisers. Planting pollinisers either in rows or as sufficient interplants (10 % pollinisers) should give consistent cropping of Pink Lady®.

2.2.4 Thinning

Fruit should preferably be thinned to singles to expose fruit to sunlight. In Australia, this variety does not have problems with fruit set. Chemical thinning is very important for this very precocious variety. In statistical and semi-commercial trials the cultivar has responded well to the following chemical thinning programmes.

Table 2. Chemical Thinning Alternatives

No.	Time of Application	Product	Dose per 100L Water
1	2 – 4 Days after full bloom	Goldenthin	70 g
2	Petal drop Not later than 7 – 12 mm fruit diameter	Planofix	11 ml
3	7 – 10 Days after full bloom	Sevin 85 % WP Or Sevin XLR Plus	60 g 100 ml
4	2 – 4 Days after full bloom	Goldenthin) +) T/Mix Promalin)	70 g 62,5 ml

Notes:

- Young trees are “ easy to thin”. As trees get older, more aggressive programmes might be needed to achieve adequate thinning.
- Spray number 4 is the most aggressive.
- Sprays 1, 2 and 4 can be followed up with Sevin 85 % WP at 60 g/100 litres water, or Sevin XLR at 100 ml/100 litres water if additional thinning is required.
- Spray number 3 can be repeated 7 – 10 days later, or at 10 – 15 mm fruit diameter if further thinning is required.
- Success with chemical thinning requires practice and keen observation.

French research has shown that a high crop load reduces fruit colour, firmness, total soluble solids and titratable acidity.

2.2.5 Harvesting

The period from blossom to release date ranges from 175 – 186 days, depending on the season and the region. Start maturity indexing at least three weeks prior to the estimated harvest date. Physiological maturity usually occurs well before sufficient pink colour develops. Seed colour is not used as a maturity indicator as the colour turns full brown before harvest. **Starch breakdown** is an important maturity parameter. The most favourable internal quality occurs at a starch conversion of 15 – 40 %. When fruit reaches 10 % starch breakdown it should be monitored carefully, as the optimum stage of harvesting may occur in the week that follows directly. Fruit growing in shaded positions in the trees show higher starch breakdown than those in well-exposed positions. This is important in the sampling procedure for maturity tests. The following guidelines, based on starch conversion, are given for storage:

- Up to 40% starch conversion for long-term storage
- Between 40 - 50% starch conversion for short-term storage
- Above 50% starch conversion for immediate marketing

The international average firmness requirement for Pink Lady® is 7 kg. It is advisable to ship the fruit at 7.2 kg or higher to achieve the above requirement in the market place. Individual retailer firmness specifications can influence the timing of harvest and, in some seasons, may be difficult to achieve. Whilst the minimum TSS requirement is 13 %, the desired level is 15 %. Although TSS increases during storage, it is not advisable to harvest at a TSS below 12,5 %. Acid levels are required to be between 0,8 – 0,4 %. Acid levels are not usually a problem, except perhaps at the upper limit at the beginning of the season.

The export Cripps' Pink maturity standards are:

Seed colour:	Full brown
Starch conversion	Minimum 15 %
Firmness	Minimum 6,3 kg (20% tolerance)

Fruit is released for harvesting approximately two weeks after the release-date of Granny Smith. With large volumes of Granny Smith, the harvesting of Pink Lady may co-incide with the harvesting of Granny Smith. In Elgin, for example, Granny Smith harvesting peaks in weeks 14, 15, 16 and 17, while Pink Lady® is harvested in weeks 16, 17 and 18.

Pink Lady has a short picking window. Depending on the situation, fruit should be harvested within a 7 to 10 day window, and this might involve three to four picks. The first crop (young trees) might be harvested in one pick only. In Australia, they consider the ideal picking window to be 10 days, to limit the development of greasiness.

Fruit should be handled carefully. Despite being a firm fruit, it is prone to **bruising**. It would be beneficial to handle these fruit the same way as Golden Delicious. Experience from California indicates that the fruit bruises more readily as maturity advances, as one can expect. Bruising has been noted as an important defect in our fruit. After harvest, fruit should be cooled down as quickly as possible and the cold chain maintained.

At harvest, fruit eating quality might not be very satisfactory. Fruit should be cold stored for four weeks to allow the unique eating quality it is known for, to develop. During this storage period, the acid level drops and the sugar becomes more pronounced, giving this apple its pleasant, uniquely balanced flavour. The fruit has a crisp and firm texture, with a very good flavour.

Avoid delaying harvest too long to allow for colour development as **greasiness** can develop on the surface. Greasiness is a major limiting factor in the storage potential of the fruit. Even though greasiness does not have any adverse effect on the internal quality, it makes fruit appear less fresh and healthy and is regarded as a defect by consumers. Greasiness is prevalent on fruit of young trees. On mature trees, it seems that greasiness increases when 40% or more starch has broken down at harvest, especially when the fruit is stored for longer periods. Trees with excessive vigour and poor light distribution result in growers delaying harvesting in order to get sufficient colour on the fruit. By delaying harvest, maturity moves past the optimum and storage life is directly affected.

Because of the critical picking window, it is important to note that if harvesting has to be postponed, alternative short-term marketing strategies must be employed. Consider the use of **ReTain** as a harvest management tool. Research by Prof Karen Theron on Pink Lady® has shown that ReTain slowed maturation, as evidenced by slower starch degradation; allowed more time for colour improvement and fruit size development; maintained firmness and background colour; and reduced greasiness and fruit drop. Research in other countries (in brackets) on the effect of ReTain has shown an increase in TSS (Australia), fewer picks (Australia) and less bruising (Chile).

Trials on the effect of Ethrel sprays on Pink Lady®, conducted by the University of Stellenbosch on behalf of Valent Bio Sciences, illustrated that there was no benefit in using this treatment. Greasiness was found to develop on the fruit whilst on the tree. Ethrel sprays are in any event not permitted for exported fruit.

2.2.6 Packout

The major factors that influence packout are the following: poor colour, sunburn, bruising, and malformity. The major criticism from the overseas market has been: poor colour, sunburn, bruising, greasiness and mixed maturities. Packout on colour varies drastically between sites. The challenge is to achieve a 60 % Pink Lady packout.

This variety is susceptible to scab and powdery mildew.

The **export colour standards** are as follows:

Pink Lady®	> 40 % colour
Cripps' Pink (Extra class)	> 33 % colour
Cripps' Pink (Class 1)	> 10 % colour

For the best return to growers, we should strive to maximize the amount of fruit acceptable for the Pink Lady® grade. The promotion and marketing invested in this brand will ensure premium prices in this category.

2.2.7 Storage

This variety can store well and has a juicy, crisp texture and well balanced taste. Pink Lady® can be stored for 7 months under CA conditions and for about 4 months under regular atmosphere conditions. The recommended ARC Infruitec-Nietvoorbij CA storage regime is: 1,5% O₂ (not lower, but can be higher) and 1% CO₂ (or lower - do not exceed) at a temperature of -0,5 °C. Note should be taken that for local marketing, unless the fruit is harvested eating-ripe, a cold storage period of four weeks is necessary for fruit to develop its characteristic flavour.

Fruit picked early in the picking window is susceptible to scald. A general recommendation for DPA treatment, for storage longer than 8 weeks is:

- < 30 % starch breakdown 1000 ppm
- > 30 % starch breakdown 500 ppm

Consider treating early picked fruit (below 30 % starch breakdown) destined for longer than twelve weeks storage, with 2000 ppm DPA.

Internal browning is considered to be the biggest factor limiting the storage potential of Pink Lady®. This problem occurs extensively internationally, and has also been encountered locally. A major contributing factor to internal browning is harvesting too late. See Appendix 3.

According to Colin Little of Australia, Pink Lady is very intolerant of carbon dioxide in CA storage. For the control of internal browning in long-term storage, he recommends an ideal carbon dioxide level of 0,5 – 1,0 %, while holding oxygen at 1,8 – 2,2 %.

The internal breakdown (IB) risk profile according to harvest maturity (starch breakdown) can be characterised as follows:

- 15 - 40 % starch breakdown for short-term storage (3 months) low risk of IB
- 30 - 40 % starch breakdown for long-term storage (> 3 months) medium risk of IB
- 40 - 50 % starch breakdown for short-term storage (3 months) medium risk of IB
- 40 - 50 % starch breakdown for long-term storage (> 3 months) high risk of IB
- 50 % + starch breakdown for short-term storage (3 months) high risk of IB

Given the size of the investment of CA storage, as well as the risk of IB, it makes sense to evaluate samples on a monthly basis. Samples can be placed in a net bag (orange/onion pocket) and placed near the door or hatch of a CA store, and be hooked out as required (take note of CA safety requirements).

According to literature, fruit is susceptible to fungal storage rots, but no significant problems have been encountered locally. Gloeosporium (bitter) rot has been observed. Infection takes place prior to harvest but symptoms of decay are only noticed after storage.

SmartFresh (1-MCP) has been registered for use (post-harvest) on apples in South Africa. According to literature, 1-MCP has been shown to maintain better firmness and acidity levels of Pink Lady®,

compared to RA and CA controls. It has further been reported to reduce superficial scald, greasiness and light internal browning of apples. The recommended maturity stage of treatment for Pink Lady® is 30 – 50% starch conversion and above 8 kg firmness. The fruit must have matured sufficiently to have developed its characteristic flavour before the application of 1-MCP. More information can be obtained at www.smartfresh.com, or Wèhan Goenewald at 082 453 4933.

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APPENDIX 1

RECOMMENDATIONS FOR RESEARCH

(Work done indicated by organisation listed)

- | | |
|---|-------------------------|
| 1. Do we need 6 Ca sprays? | |
| 2. What is the norm for N in the leaves? | |
| 3. What does a leaf norm of 1.8 - 1.9 % do to trees in the full bearing phase? | |
| 4. Investigate the effect of Mancozeb sprays on the background and blush colour. | |
| 5. Evaluate leaf nutrition programmes to determine whether high levels of Mn has an influence on the background colour. | |
| 6. Effect of spraying P late in the season to increase fruit colour. | |
| 7. Determine the effect of minerals on the storage potential of fruit. | Hortec |
| 8. The effect of summer pruning a few days before harvest on sunburn. | Fieldsmen |
| 9. Investigate the development of greasiness. | Hortec |
| 10. Determine the incidence of scald. | Hortec/Infruitec |
| 11. Determine the effect of DPA treatment. | Infruitec |
| 12. Maturity indexing. | Hortec |
| 13. Investigate CA storage-regimes. | Infruitec |
| 14. Would it be beneficial to store fruit in bags? | |
| 15. The effect of ethrel sprays on ripening. | US |
| 16. Trials regarding chemical thinning and the registration of products. | US |
| 17. Establish a standard growth curve for Pink Lady. | E Lötze |
| 18. Relationship between bruising and recommended picking maturities. | |
| 19. Effect of ReTain on Pink Lady. | US/Hortec |
| 20. Application of 1-MCP. | Dr I Crouch |
| 21. Factors influencing internal browning | |

APPENDIX 2



Pink Lady™

MINIMUM INTERNATIONAL QUALITY SPECIFICATIONS AT DESTINATION

MAJOR DEFECTS

DEFECTS	ALLOWABLE LEVEL	TOLERANCE
Bitter Pit	Nil.	No more than 3% of fruit in box with minor damage permitted.
Bruising	No individual bruise greater than 10 mm diameter Maximum total area per apple 100 square mm.	No more than 3% of fruit in box to exceed allowable level.
Core Rot	Nil.	No more than 1 % of fruit in box with core rot permitted.
Cracks	Nil.	No more than 3% of fruit in box with cracks permitted.
Decay	Nil.	No more than 1% of fruit in box with decay permitted.
Greasiness	Nil.	No more than 3% of fruit in box with an excessive oily feel permitted.
Hail Marks	Nil.	No more than 3% of fruit in box with minor hail damage permitted.
Mixed Cultivars	Nil.	Nil.
Scald	Nil.	No more than 3% of fruit in box with minor scald permitted.
Sunburn	Where sunburn adversely affects the blush colour the fruit does not qualify.	No more than 3% of fruit in box with minor colour bleaching permitted.

MINOR DEFECTS

DEFECT	ALLOWABLE LEVEL	TOLERANCE
Acid levels	Between 0.4 and 0.8.	Nil.
Blemishes	No more than 8% of fruit may have a single mark up to 20 mm long and a total area no greater than 100 square mm.	Nil.
Brix	Average 15% or greater Minimum 13%.	Nil.
Chemical Burn	Nil.	No more than 1% of fruit in box with minor damage permitted.
Colour	No less than 40% of the surface area of a fruit must be covered by a bright pink over a cream pale-green, but not yellow, background.	Nil.
Dirty Fruit	Fruit must be clean but dust allowed in lower halves of stem and calyx ends.	No more than 8% of fruit in a box may have excessive dust in stem and calyx.
Firmness (Pressure)	Average 7.0 kg (15.4 lbs) or greater. Minimum 6.8 kg (15.0 lbs). <i>Measured with a 11 mm penetrometer.</i>	No more than 10% of fruit in a box may be down to 6.5 kg (14.3 lbs).
Fusicladium or Black Spot	No more than 8% of fruit may have a single spot of 5mm diameter.	Nil.
Hammering and Ridging	Permitted as long as uneven surface is not discoloured.	No more than 8% of fruit in a box may be have slight hammering and ridging.
Insects	Record if harmful insects found.	No more than 3% of fruit in box may have live insects present.
Insect Damage	Nil.	No more than 1% of fruit in box may exhibit insect damage.
Lenticel Pit	Five stains of light intensity allowed on a single fruit.	No more than 4% of fruit in a box may have slight lenticel pit above this level.
Lenticel Spot	One spot allowed on a single fruit.	No more than 4% of fruit in a box may have slight lenticel spot above this level.
Malformations	Fruit must not be more than 10 mm off-shape at eye of the fruit.	Up to 8% of fruit in a box may be between 10 and 20 mm off shape.
Mechanical Injury	Nil.	No more than 3% of fruit in box may have slight mechanical injury.
Russet	Russetting not to extend outside the calyx basins.	No more than 8% of fruit in a box may have slight russetting outside the calyx basin.
Mites	No colonies more than 6 mites/colony	No more than 3% of fruit in box may have more than the specified number of mites and colonies

Total major defects must not exceed 3%, with no more than 1% in any major defect category.

Total defects (major + minor) must not exceed 10 % eg. 3% major and 7 % minor OR 0% major and 10 % minor.

Pink Lady Spec.301202

APPENDIX 3

INTERNAL BROWNING

Summarised information of a report by Dr Colin R. Little, Melbourne, Australia

Factors Predisposing Pink Lady® to Internal Browning

1. Over maturity

Over maturity is thought to be a major predisposing factor. Fruit with a starch conversion of 50% and higher pose a serious risk for CA storage past mid-July and should not be exported.

2. Slow attainment of CA conditions

Taking longer than 10 days to fill, seal and activate the gas regimes of a CA room.

3. Rapid cooling

Stepwise cooling is preferred for CA. This involves rapid cooling to 4 °C, followed by a 10-day storage period, whereafter the fruit is cooled to 2 °C and stored for a further 10 days, followed by storage at 1 °C for the remainder of the storage period.

4. Off cropping

Off cropping results in larger apples and increased tree vegetation which, in most instances, coincides with reduced calcium and phosphorus levels and reduced storability. The recommended number of fruit per centimetre stem circumference is 10,5 – 12,5. Lower values increase the risk.

5. Fruit of grafted trees

Surveys have shown that fruit of grafted trees were less uniform in maturity and quality, and had a higher propensity to internal browning in medium-term CA storage.

6. Fruit of cooler locations

Surveys have shown that fruit of cooler regions were more prone to internal browning than fruit of warmer regions, although there were exceptions to this generalisation.

7. Low calcium, phosphorus levels

Worldwide, high calcium and phosphorus levels are known to improve the storage quality of apples. Appropriate zinc levels help in mobilising calcium in the tree system early in the season. High nitrogen robs fruit of calcium by diverting the available calcium to vegetation.

Factors that reduce Internal Browning in Pink Lady®

1. High calcium and phosphorus

Easier to achieve on smaller trees with reduced vigour.

2. High crop load

A high crop load results in a more homogenous fruit population with less variability in firmness, sugar, starch conversion and colour development.

3. Warm climatic conditions

4. Prompt attainment of CA conditions

CA rooms should be filled within 7 days, with oxygen reduction commencing no later than 12 hours after sealing.

5. Optimum maturity

Harvesting at optimum maturity, that is within 10 days of the release date, is the key to eliminating physiological disorders in long-term CA.

6. Maximum light penetration

This is achieved by limiting basal branch length to one metre.

APPENDIX 4

MINERAL ANALYSIS SUMMARY

	FRUITLETS (All elements mg/100g fresh weight)							FRUIT (All elements mg/100g fresh weight)						
	Fruitlet mineral analysis results (± 62 Dafb)							Fruit mineral analysis results (± 2 Weeks before harvest)						
Year	N	P	K	Ca	Mg	FRUITLET MASS(g)	MOISTURE (%)	N	P	K	Ca	Mg	FRUIT MASS(g)	MOISTURE (%)
2002	90.0	15.3	165.0	13.6	11.2	22.7	84.6	37.9	8.1	110.2	5.3	5.7	146.9	82.2
2001	46.6	12.9	148.6	10.9	10.2	26.2	84.2	35.8	9.0	112.6	5.5	5.8	140.4	83.1
2000	113.6	12.7	122.5	12.0	8.5	31.4	83.9	40.8	7.1	79.7	5.7	4.2	114.7	83.8
1999	77.4	11.9	147.4	10.5	9.3	21.9	85.1	25.6	9.2	97.9	6.7	5.0	156.7	83.5
1998	56.7	10.7	137.2	13.6	9.7	24.9	85.3	22.2	9.3	97.9	7.7	6.2	138.7	82.6
AVG:	76.9	12.7	144.1	12.1	9.8	25.4	84.6	32.4	8.5	99.7	6.2	5.4	139.5	83.0