Module 8
Rind Disorders

Presenter: Paul Cronje

Introduction

Rind disorders are physiological defects that occur on the citrus rind, or peel. They are not caused by pathogens, such as fungi.

There are a number of citrus rind defects, with different causes and preventative measures. It is important for the grower to be able to identify rind disorders correctly and to know what preventative steps can be taken to control them.

These defects are different from pathological problems that have to do with fungal infections. These disorders are physiological, caused by something in the rind that causes cells to degenerate, resulting in unsightly scars.

Rind Structures and Functions

The citrus rind is a modified leaf, with an interesting and complicated physiology. The rind can photosynthesise, respire and transpire just like an ordinary leaf.

It is important during fruit growth that this leave must develop optimally. It must contain high levels of minerals, especially magnesium and calcium, to strengthen cell walls and membranes.

Photosynthesis

Photosynthesis literally means production through light (photo=light, synthesis=production) and is the process by which green plants turn carbon dioxide and water into food using sunlight energy.
Respiration

Respiration is an energy-producing oxidation process in cells, the complete chemical and physical process in which oxygen is delivered to plant cells and carbon dioxide and water are given off. The plant takes up oxygen ($O_2$) and releases carbon dioxide ($CO_2$).

Transpiration

Transpiration means to lose water through the surface of a plant, particularly through the stomata in the leaf surface.

There must be sufficient carbohydrates in the rind, which it mostly generates through its own photosynthesis. These carbohydrates provide energy for cellular processes, and must also provide sufficient energy for postharvest respiration.

The moisture balance of the rind is very important. Water provision during rind development must be maintained through good irrigation.

Production Guidelines

Please consult volume II, section 1 of the CRI Production Guidelines for more information on plant nutrition.

Postharvest Practices

Drenching

When the fruit is harvested, the heat in the fruit, caused by sunshine, must be removed as soon as possible. This means the field heat must be taken out of the fruit.

The best way is to drench the fruit at the packhouse, in a drench system that also contains fungicides. Water moving over the fruit and evaporating from the rind removes the heat. This prevents excessive moisture loss from the fruit.
The Packline

After being harvested and before being packed, the fruit moves over the packline, which has many moving parts, such as rollers and brushes.

These must be kept in good condition to prevent injuries to fruit. Any small injury will lead to a lot of moisture being lost from the rind.

Wax Application

Wax application is an important aspect of the packing process. All citrus fruit needs a wax application to limit moisture loss.

The right wax must be selected according to the cultivar and the market. The wax must be permeable enough to release CO$_2$ from the fruit, and to allow oxygen to enter the fruit.

Logistics

Chilling injury is a rind defect that is becoming more important to citrus growers as imports increase to countries requiring a cold sterilisation protocol. Such protocols are applied in exports to countries such as the USA, Japan, South Korea and China.

It is important to know that the longer the fruit is exposed to these low temperatures, the more chilling injury will occur. All the participants in the logistics chain must be careful not to expose fruit to these low temperatures for longer than required.

Rind Disorders

We have now looked at the main causes of rind defects. Next we look at the groups into which specific disorders are classified.
Rind Pitting

The first important one is the rind pitting or rind breakdown group.

This is normally caused by a perforated oil gland in the rind from which oil leaks, causing brown marks as the oil destroys cells and their contents oxidise. This usually happens about two to five weeks after harvesting, which means that the fruit looks in a good condition when it is packed and shipped, but develop blemishes before arriving at the market, where it then has to be destroyed.

To prevent this disorder, production practices such as fertilisation, irrigation and handling must be monitored closely.

Peteca Spot

Peteca spot on lemons is an interesting defect. It is also associated with the degeneration of oil glands in lemon rind, but it happens very quickly, as little as two or three days after harvesting.

We have found that fruit is more sensitive when harvested after a cold front, especially if it was accompanied by rain.

An important aspect that must be addressed in the packhouse is the choice of wax. A wax with a good exchange capacity must be selected. CO₂ must be able to leave the fruit and oxygen must be allowed in. A high build-up of CO₂ around the fruit usually causes more peteca.

Oleocellosis

Oleocellosis is a well-known defect. Here the oil gland is damaged physically during picking and handling. The oil leaks onto the rind surface, destroying the outer cell layers.

These cell layers contain the carotenoid pigments that give the fruit its orange colour. As the fruit colour develops, you get dark brown spots on the orange rind.
Chilling Injury

A defect that is of increasing significance in South African citrus is chilling injury.

Citrus is naturally a subtropical fruit, and is therefore very sensitive to low temperatures. But markets such as the USA, South Korea, Japan and China, require a cold sterilisation protocol for export fruit.

Chilling injury can be limited by making exposure time as short as possible. The logistic chain must be well-designed, and every role player must realise that the longer fruit is exposed to those low temperatures, the greater the danger of chilling injury.

Module Reference

For best practices in terms of handling fruit during picking, please refer to module 13 – Picking Practices and module 14 – Picking Supervision, and for more information on the importance of the cold chain, please consult module 47 – Cold Chain Review.

summary

Rind Disorders

<table>
<thead>
<tr>
<th>Name</th>
<th>Cause</th>
<th>Prevention</th>
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</thead>
<tbody>
<tr>
<td>Rind pitting</td>
<td>Insufficient irrigation and plant nutrition, Injuries during harvesting and packing</td>
<td>✓ Good production practices, ✓ Cautious fruit handling</td>
</tr>
<tr>
<td>Peteca spot</td>
<td>Harvesting during or after a cold front, Wax with insufficient exchange capacity</td>
<td>✓ Good harvesting practices, ✓ Choosing wax with good exchange capacity</td>
</tr>
<tr>
<td>Oleocellosis</td>
<td>Oil gland damage during handling</td>
<td>✓ Cautious fruit handling</td>
</tr>
<tr>
<td>Chilling injury</td>
<td>Exposure to low temperatures for too long periods</td>
<td>✓ Proper management of logistics chain</td>
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</tbody>
</table>
Conclusion

To limit and control rind disorders it is important to look at production practices, specifically plant nutrition and irrigation, to ensure that the fruit is handled carefully during picking and packing, and to make sure that good packhouse practices are applied, especially when it comes to wax applications.

active learning

Watch the DVD clips, read through the learning material and do workplace research to gather the knowledge and information to complete the assignment(s) below.

Activity 8.1 – Worksheet

Complete the table in your workbook stating for each disorder in the pictures below:

- What is the name of the disorder?
- What causes this disorder?
- When do the symptoms of the disorder first appear?
- How can the disorder be prevented?

Activity 8.2 – Staff Training

Make a list of five specific things that can be done on the farm and / or in the packhouse to prevent most rind disorders. Now develop a learning session for the employees on a citrus farm and in a citrus packhouse during which you explain to them these five things.
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<th>Timing of symptoms</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Image 1" /></td>
<td><img src="image2.png" alt="Image 2" /></td>
<td><img src="image3.png" alt="Image 3" /></td>
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Keynotes: