CRI Cutting Edge
RESEARCH NEWS FROM CITRUS RESEARCH INTERNATIONAL
November 2012 No 151

Endoxerosis of Lemon Fruit: Proposed re-classification of inspection guidelines

by
Paul Cronje and Hennie le Roux
(Citrus Research International),
Cyril Julius and Jurgens Bence (PPECB)

Background

Endoxerosis of lemon fruit is a physiological disorder that develops post-harvest and can lead to rejections during inspections. The disorder occurs in all lemon production areas of South Africa and is more prevalent in the first part of the season. No specific cultural practice is known to effectively prevent endoxerosis, however, low potassium levels as well as water stress and high temperatures during fruit development, especially close to harvest, have been associated with a higher incidence of this disorder. In addition, overripe fruit should not be harvested for export as they are prone to this disorder.

The main difficulty with endoxerosis is to identify fruit with this disorder, as affected and non-affected fruit look similar externally. The only way to determine the presence of endoxerosis in a sample of fruit is to cut fruit open and grade these fruit on the degree of symptom development.

During 2012 a high incidence of lemon fruit were reported that developed preliminary symptoms of endoxerosis. This led to rejections of pallets in spite of the more classic symptoms normally used to implement rejections for endoxerosis, i.e. drying out of the sap vesicles and pink/brown discoloration of pulp at the stylar end, being absent. Fruit that showed these preliminary symptoms that were kept for an extended period did not develop any additional symptoms associated with this disorder and no negative quality feedback was received from the market. As a result of this experience it is proposed that the definition as well as the grading classification of endoxerosis should be reviewed in order to clarify rejection parameters by PPECB.

Symptom development of endoxerosis

External symptoms

Endoxerosis symptoms develop independent of rind colour, and it is only on very severe endoxerosis-affected fruit that a deep yellow rind colour is evident. In some fruit the disorders may lead to a partial loss of lustre at the stylar end. However, neither of these two external quality aspects are a sure indication of the internal development of endoxerosis.

Internal symptoms

- The preliminary symptom of endoxerosis is the brown vascular bundles at the stylar end of the fruit. As the severity of the disorder increases the bundles begin to be clogged with a pinkish to rust brown deposit of gum. Further development leads to a rust-brown rind colour near the stylar end.
- During the second stage of symptom development, the juice sacs of the pulp adjoining the rind at the stylar end become affected and lose water and collapse. The collapsed or dried out pulp does not normally develop a discoloration.
- In sever symptom development the vascular bundles in the central axis become discoloured and filled with brown gum. The water loss/drying out of the pulp, which started at the stylar end, progress down to the center of the fruit. The dried out pulp could develop into a pinkish or light brown colour.

Advised inspection procedure to identify endoxerosis symptoms

Endoxerosis is not normally visible externally; it is therefore advisable to cut the lemon fruit open at the stylar end and core of the lemon to see if endoxerosis is present (see figure below). It is important that the cut is made into the pulp and not only into the albedo of the stylar end in order to identify the symptoms occurring in the pulp/juice sacs (drying out and discolouration). It is advised that the inspector start to cut the fruit from the stylar end in 0.5cm increments in order to determine where symptoms start to develop. Normally the juice sacs at the stylar end and core of the fruit will lose water and dry out, appearing similar to granulation. The albedo at the stylar end will develop a pink to light brown colour. Juice sacs around the core of the lemon will develop a brown colour and be filled with gum.

Classification and grading of endoxerosis severity

Current grading of endoxerosis by PPECB standards:

Fruit must comply to a minimum standard of a 5% level for minor Endoxerosis and 1,5% for major endoxerosis:

"minor endoxerosis" means pink to light brown discolouration at the stylar end and core of the fruit together with drying out of the juice vesicles;

"major endoxerosis" means the dark brown to black discolouration stage affecting the albedo and core of the lemons with or without tissue collapse and water saturation;

CRI Cutting Edge
RESEARCH NEWS FROM CITRUS RESEARCH INTERNATIONAL
November 2012 No 151

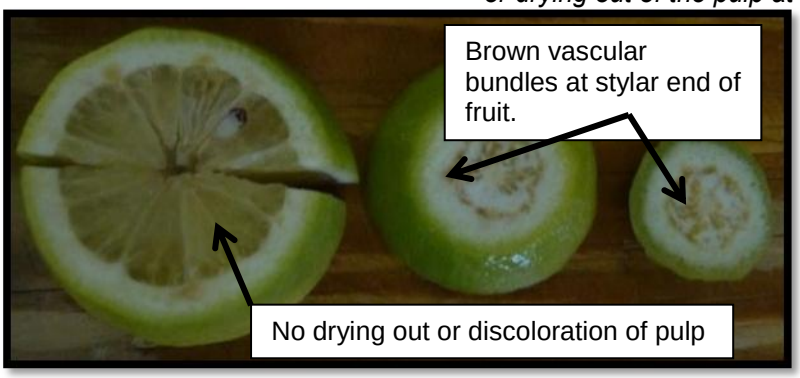
Proposed expanded endoxerosis grading standard:
It is proposed that an additional classification for endoxerosis be included in the PPECB grading system. This additional descriptive class will describe the first or preliminary symptoms of an endoxerosis sensitive fruit, before it develops minor or major symptoms that could lead to rejection of the fruit for export.

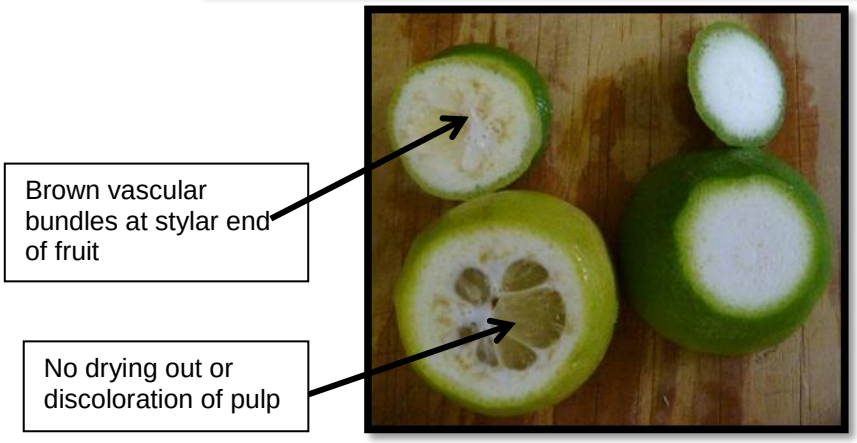
The three proposed classes are as follows:

1. Preliminary endoxerosis symptoms: no rejection on these symptoms.
2. Minor endoxerosis: Fruit rejected if 5% show these symptoms.
3. Major endoxerosis: Fruit rejected if 1.5% show these symptoms

Fruit that show any preliminary symptoms will not be classified as endoxerosis, however fruit that show 5% of minor or 1.5% of major endoxerosis symptoms will be classified as such.

1. **Preliminary endoxerosis symptoms**: *"slightly brown discolouration of vascular bundles in albedo at stylar end. No further discolouration or drying out of the pulp at stylar end".*

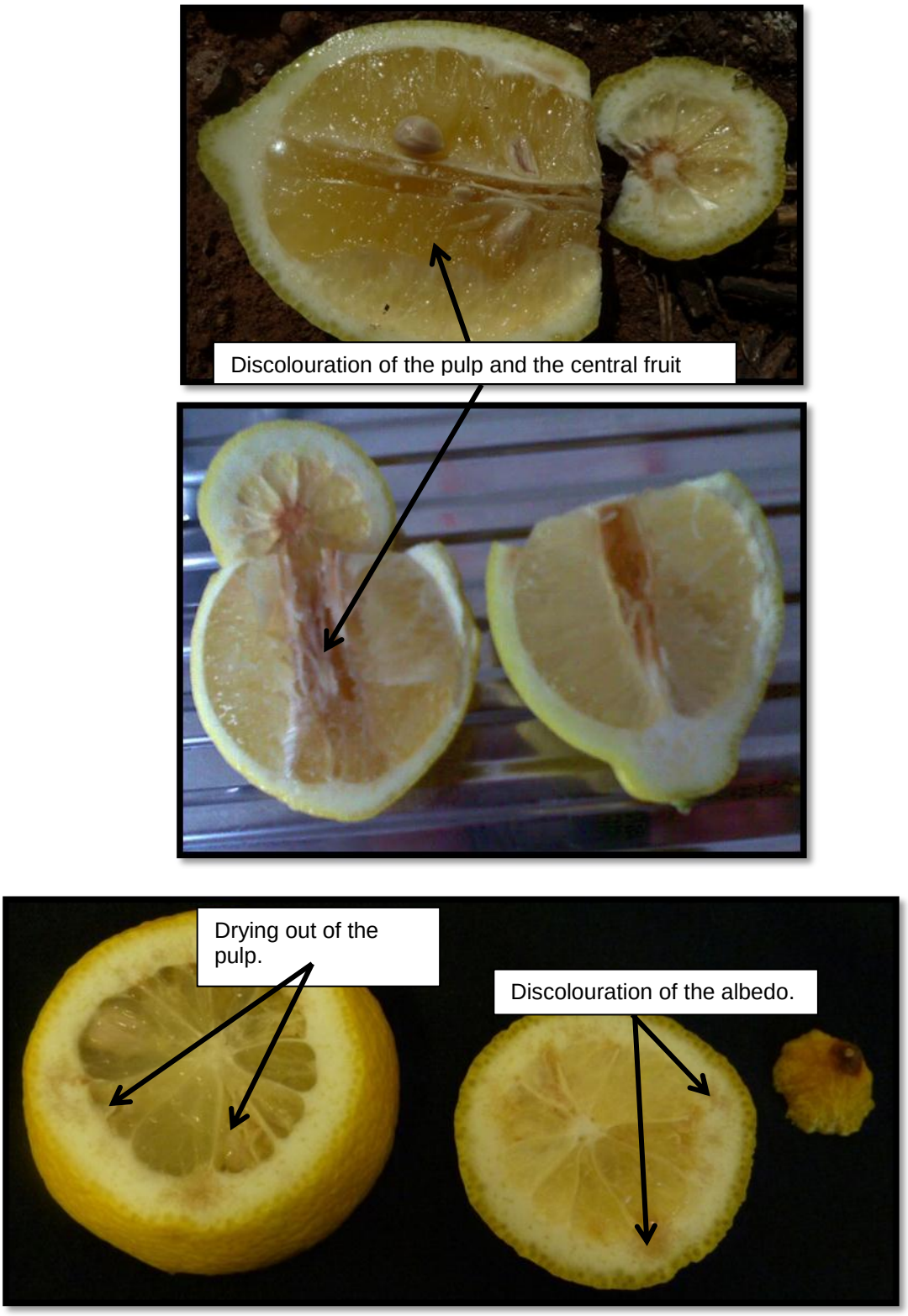




Figures indicating the preliminary symptoms of endoxerosis: brown discolouration of the vascular bundles at the stylar end. No discolouration or drying out of the pulp has occurred.

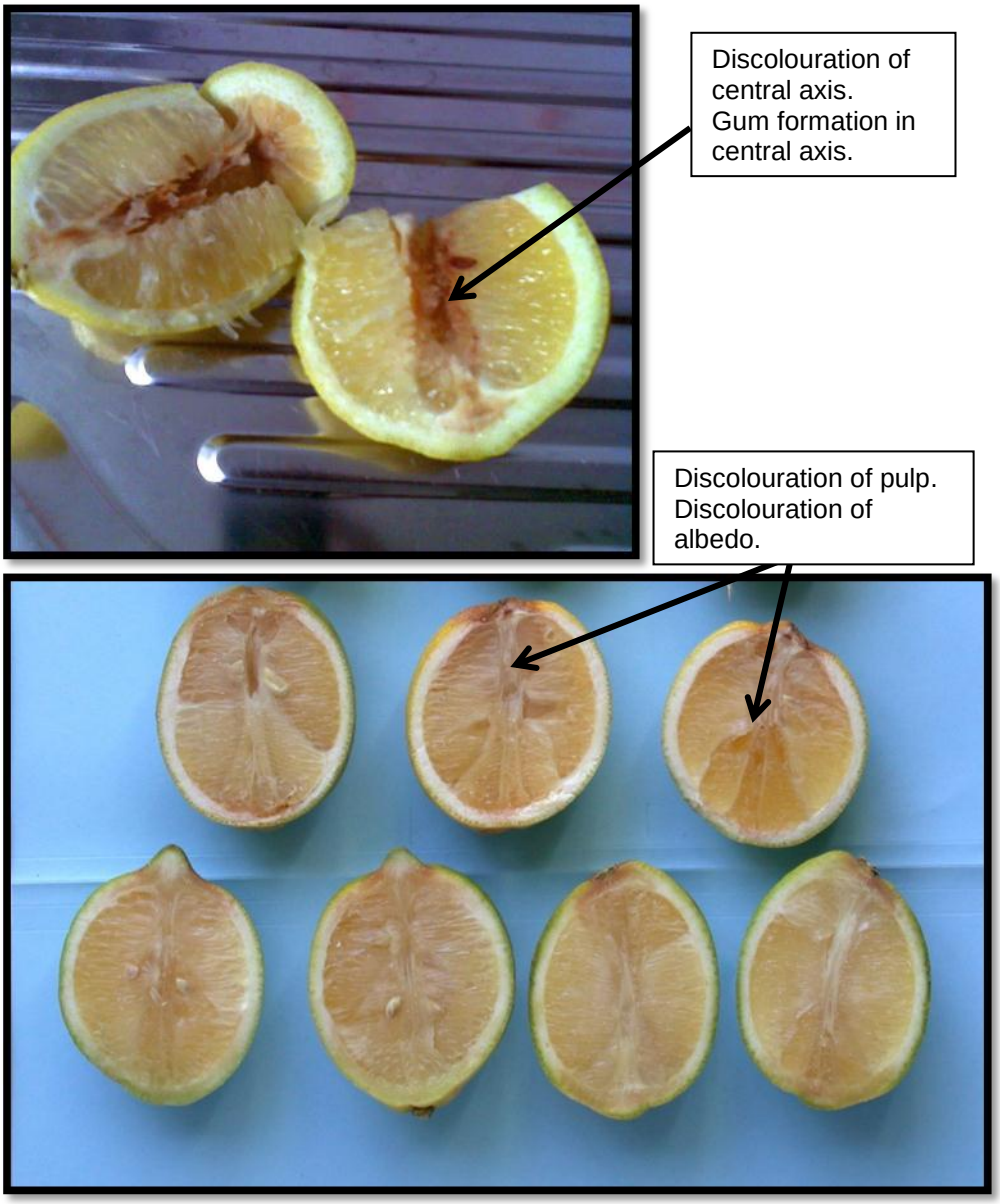
2. **Minor Endoxerosis**: *"pink to light brown discolouration of the pulp at the stylar end and core of the fruit together with drying out of the juice vesicles at the stylar end"*

CRI Cutting Edge
RESEARCH NEWS FROM CITRUS RESEARCH INTERNATIONAL
November 2012 No 151



Figures indicate minor endoxerosis symptoms. Note the discolouration of the albedo (top) and the discolouration of the pulp to a pink brown colour (bottom). In the bottom photo drying out of some of the juice vesicles has occurred.

3. **Major Endoxerosis**: "*dark brown to black discolouration occurring in the albedo as well as the core/central axis of the lemons with or without tissue collapse and water saturation. In addition the collapsed pulp tissue could include gum formation of the vascular tissue".*



Figures show lemon fruit with various symptoms of major endoxerosis *viz*. discolouration of pulp, albedo, the central axis as well as gum formation in the central axis.