SA LITCHI GROWERS’ ASSOCIATION

SULPHUR DIOXIDE

Compiled by Gerhard Nortjé with the input of relevant experts

This fact sheet answers the most frequently asked questions (FAQ’s) about sulphur dioxide in the litchi industry. For more information call SALGA at 015 307 3676.

HIGHLIGHTS: Sulphur dioxide (SO₂) fumigation is commercially used on litchi fruit in South Africa, Reunion, Thailand and Israel. Being an anti-oxidant, it has an inhibiting effect on polyphenol oxidase activity, the enzyme responsible for browning. Sulphur dioxide also prevents colour loss by fixing anthocyanins. In addition it controls saprophytic surface fungi. Normally, sulphur dioxide bleached fruit return to a uniform pink colour after 3-5 days under ambient conditions at 22°C. Excessive treatment, however, results in Maximum Residue Level (MRL) infringements, taste issues and yellow fruit not returning to the original red colour.

What is sulphur dioxide?

Sulphur dioxide is a colourless gas with a pungent odour. It is a liquid when stored under pressure, and it dissolves in water very easily.

Sulphur dioxide in the air comes mainly from activities such as the burning of coal and oil at power plants or from copper smelting. In nature, sulphur dioxide can be released to the air from volcanic eruptions.

What happens to sulphur dioxide when it enters the environment?

- When released into the environment, sulphur dioxide moves into the air;
- In the air, it can be converted to sulphuric acid, sulphur trioxide, and sulphates.

What are the properties of sulphur dioxide?

- Being an anti-oxidant, sulphur dioxide has an inhibiting effect on polyphenol oxidase activity, the enzyme responsible for browning, while it also prevents colour loss by fixing anthocyanins;
- In addition, it controls saprophytic surface fungi and retains the pliability of the skin so that it does not split so easily during handling;
- The main problem with the SO₂ treatment is that it rapidly bleaches the pericarp surface due to the formation of a colourless anthocyanin-SO₃H complex, causing the other pigments, especially carotenoids to be revealed;
- Normally, bleached fumigated fruit will return to a uniform pink colour after 3-5 days under ambient (room temperature) conditions at 22°C;
- The degree of colour recovery depends on the rate of SO₂ release and is a function of airflow and storage temperature;
- Some of the SO₂ remains chelated to the anthocyanins and excessive treatment results in yellow to pale green fruit that does not return to the original colour.

What is the fumigation procedure?

The SO₂ treatment entails fumigating the fruit with sulphur dioxide gas. This can be done with compressed gas injected directly into a sealed chamber containing the fruit to be treated. Alternatively, sulphur powder can be burned to form a gas (in this case SO₂ ends up on the fruit skin, and the following chemical reaction is involved:

\[ \text{S} + \text{O}_2 \rightarrow \text{SO}_2 \]

See “The cultivation of Litchis”, pp. 219-221, for further information on facilities used for fumigation.

Maximum Residue Levels (MRL’s):

- The EU and Default Export MRL for litchis is 10ppm (flesh), whereas the SA MRL = 55ppm (flesh) and 1000ppm (peel);
• An MRL for export to the US is still to be determined (possibly 10ppm).

Fumigation time under different climatic conditions: the following table serves as a guideline.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Fumigation time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 28°C</td>
<td>28 minutes</td>
</tr>
<tr>
<td>Sunny: Temp &gt; 28°C; low RH</td>
<td>26 minutes</td>
</tr>
<tr>
<td>Cloudy: RH &gt; 80%</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Rainy: RH = 100%</td>
<td>32 minutes</td>
</tr>
</tbody>
</table>

Calibration of the fumigation unit
• It is of utmost importance to calibrate the fumigation unit. 0.107 g. of SO$_2$/litre head space is enough to preserve the skin;
• The fumigation unit should only be filled half to two thirds of capacity. SO$_2$ is heavier than atmospheric air; therefore fans are needed to ensure even distribution.

Climatic factors that influence SO$_2$ residues
• Effect of application temperature on flesh residues: residues increase as the application temperature increases;
• Effect of Relative Humidity (RH) on day of application on flesh residues: residues increase as relative humidity decrease;
• Effect of fruit maturity on flesh residues: residues increase as maturity increase;
• Effect of period between harvest and fumigation on flesh residues: residues increase sharply when fumigated later than 3 hours after harvest;
• Be careful of excessive treatment when: very hot, humidity is low, TSS/TA values are high (advanced maturity), when fumigated later than 3 hours after harvest (fumigate as soon after harvest as possible), and lastly it is cultivar related - 'McLean's Red' vs. 'Mauritius': 'McLean's Red' are more likely to have high residue levels than 'Mauritius'.

Gas fumigation vs. sulphur burning:
• The following benefits of gas fumigation vs. sulphur burning: time saving, safety, more practical;
• The following shortcomings of gas fumigation vs. sulphur burning: The MRL's are more often exceeded during gas fumigation than sulphur burning.

Undesirable effects of sulphur dioxide fumigation on litchi fruit quality:
• SO$_2$ fumigation can result in health hazards to packhouse workers and consumers causing allergic reactions and respiratory problems. Therefore it is very important to wear the right protective clothing, and make use of extractor fans etc.
• A small proportion of the litchi consumer population is allergic to SO$_2$. Therefore the litchi cartons need to be clearly marked indicating that the fruit was fumigated with sulphur dioxide.

Conclusions:
• Residue levels are influenced by a combination of factors as explained above. These factors need to be correctly managed to ensure SO$_2$ remain within specific levels and the appearance and taste of fruit is not negatively influenced;
• Because of all the undesirable effects of SO$_2$ fumigation mentioned above, it is of utmost importance to look for alternative methods of post-harvest disease control on litchis.

References:
• Botha, B. M. 2010. Personal Communication
• Beghin, S. 2010. Personal Communication
• Kruger, F. J. 2010. Personal Communication
• Schoeman, M. H. 2010. Personal Communication
• Sivakhumar, D. 2010. Personal Communication
• Stolz, B. 2010. Personal Communication