Mild chilling injury of banana (Cavendish cv. *Williams*) and its control in the field

Bradley Voules Harvey

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Abstract

Chilling injury in banana fruit is caused by prolonged exposure to temperatures less than 13°C. This can occur during bunch development in the field or postharvest handling and storage. Mild symptoms of chilling injury are localised to peel tissue and reduce visual quality of fruit. Light microscopy was used in the present study to analyse symptoms of mild chilling injury in Cavendish cv. *Williams* banana. Following storage at 5°C for 24hours, symptoms of chilling injury in the form of brown discolouration was observed within laticifers in sub-epidermal peel tissue. Browning was not observed in other vascular tissues as previous research has suggested.

Causal mechanisms associated with browning of latex within laticifers were investigated. Polyphenol oxidase (PPO) activity in fractions of banana peel latex was measured and found to be highest in the lutoid fraction. PPO activity also provided indirect evidence that phenolics were present in peel latex. Literature suggests possible compartmentalisation of PPO and phenolics in banana lutoids. In this study it is suggested that PPO and phenolics associated with lutoids in banana peel latex may be involved in browning due to chilling stress. The lipid content of lutoids from banana latex was also investigated using FTIR spectroscopy, but showed no further involvement of lutoids in the browning reaction caused by chilling.

Control of field chilling using modified bunch covers was investigated. Bunch covers used in modern banana production are usually polyethylene bags, placed over bunches

during development in the field. Experiments in a northern Queensland plantation investigated effects of modified bunch covers on fruit yield and quality characteristics of Cavendish cv. *Williams* bananas, including the development of mild chilling injury symptoms. A further field trial was conducted using different coloured bunch covers with varied interception of photosynthetically-active radiation (PAR), to determine any negative effects of bunch cover shading on fruit yield and quality.

Different coloured and layered polyethylene films (blue, double green, silver yellow and silver black) modified PAR transmission of bunch covers (PAR transmission [%] = 56, 38, 7, 0). During summer 2003, varying PAR transmission of bunch covers significantly affected fruit size. Fruit from blue polyethylene covers, which transmitted most light, were larger than fruit from covers with less light transmission. Between cover treatments of lower light transmission, fruit size remained similar. It is suggested, during summer when cloud cover in northern Queensland limits solar radiation, bunch covers with high PAR transmission facilitate greater bunch photosynthesis, which improves fruit size. Fruit quality was generally unaffected by varying PAR transmission of bunch covers, but cover treatments were found to influence peel colour. Peel colour of fruit from 'silver black' covers was significantly paler. This may have impacted upon green life due to increased de-greening. Results from this experiment suggest that bunch photosynthesis significantly influences fruit size and peel colour during summer growing periods.

Modified bunch covers constructed from existing bunch cover films and polyethylene bubble wrap ('blue + silver bubble' and sealed and non-sealed 'silver blue + silver

bubble') were used to test control of field chilling during winter 2003 and 2004. Compared to standard blue polyethylene bunch covers, modified covers significantly reduced exposure of bunches to chilling conditions in the field and the development of visible chilling injury symptoms on the peel surface and in underpeel tissue. Greatest control of field chilling was shown using the non-sealed 'silver blue + silver bubble' cover design. Relative to the standard blue cover, in winter 2003 the non-sealed 'silver blue + silver bubble' cover design reduced chilling exposure by 95% at the top and 45% at the bottom of bunches. This totally controlled chilling injury symptoms in the top and middle bunch regions. In winter 2004 chilling conditions were more severe and chilling exposure was reduced by 85% using the non-sealed 'silver blue + silver bubble' cover. This reduced the severity of peel surface chilling symptoms by 67% in the top bunch region relative to fruit from blue covers.

Yield characteristics were positively influenced by 'blue + silver bubble' and sealed and non-sealed 'silver blue + silver bubble' covers. Improved fruit size and weight was probably due to enhanced temperature conditions inside the bunch environment, relative to 'control' covers. Fruit quality was generally unaffected by 'blue + silver bubble' and sealed and non-sealed 'silver blue + silver bubble' covers. However peel colour was significantly influenced by these cover treatments, compared to the 'control' covers. Reduced light transmission of covers produced paler fruit. This may have influenced other quality characteristics, such as green life and SSC levels, as it confounded assessment of ripening stage.