

SYMPTOMS OF CONTROLLED ATMOSPHERE DAMAGE IN AVOCADOS

C. YEARSLEY AND N. LALLU
HortResearch, Private Bag 92 169, Auckland

ABSTRACT

Fruit quality following CA shipping has been variable with the appearance of a range of symptoms that lead to fruit rejection. Fruit were held under controlled atmosphere (CA) conditions in order to observe development of physiological disorders. Information was collected on how symptoms of CA and low temperature damage develop on Hass avocados. The appearance of chilling injury under CA and air storage was also compared.

Keywords: low oxygen damage, chilling injury, fuzzy patches

INTRODUCTION

Controlled atmosphere (CA) technology has been used for the transport of New Zealand avocados to export markets. Based on overseas experience and guidelines from shipping companies several different atmospheres have been used commercially. Fruit quality following CA shipping has been variable with the appearance of a range of symptoms that lead to fruit rejection and losses during distribution and sale. Invariably, rots have been associated with these symptoms.

As part of the CA research programme on avocados being undertaken at the Mt Albert CA facility, information on the symptoms of CA and low temperature damage has been collected on Hass avocados. In particular, the possibility that chilling injury expresses differently under CA and air storage was investigated.

In this brief report, a description of the symptoms of low O₂ injury and chilling injury is presented and compared with rot symptoms on green fruit ('measles'), the disorder most commonly observed at out-turn in the USA season in the 1999-2000 season.

METHODS

Commercially harvested and graded fruit were pre-treated in air at 2°C for 4, 12, 24 or 48 hours or 5°C for 24 hours. After pre-treatment the fruit were stored in air, 0.1 to 5% O₂, 2 to 20% CO₂, or combinations of O₂ and CO₂ atmosphere at 5°C for up to 3 weeks. Fruit were then ripened in air at 20°C and evaluated for the occurrence of low O₂ injury, CO₂ damage and chilling injury.

RESULTS AND DISCUSSION

Low O₂ injury

Damage from low O₂ is characterised by irregularly shaped, brown or chocolate brown discoloration of the skin predominantly at the stem-end of the fruit although any part of the fruit skin may be affected (Fig. 1B, 1D). Initially,

upon removal from low O₂ the affected area may have a light green water-soaked appearance that within minutes or hours becomes brown or dark brown (Fig. 2). Once formed the affected areas do not increase in size. The discoloured areas of skin are firm although the entire skin may be affected. The flesh under the affected skin is usually not affected, but when it is diffuse browning of the flesh occurs in the region of the affected skin (Fig. 1F). As the fruit ripen, the dark brown discoloration merges with ripening-associated changes in skin colour from green to black. The affected skin may then develop rot lesions.

CO₂ damage

No CO₂ damage was found with concentrations in the range 1 to 20%. Fruit stored in high CO₂ (7-10%) are likely to ripen slower and take longer to reach eating firmness than fruit stored in low (3-5%) CO₂, irrespective of the O₂ level.

Chilling injury

External symptoms include a series of small (2-5 mm²) irregularly shaped charcoal-black discoloured areas of skin anywhere on the skin of the fruit although the series of small affected regions or spots may all be located on one side or region of the fruit (Fig. 1A, 1C). Skin regions between and around the lenticels are affected equally, and the small spots may coalesce to form a single zone of affected skin. The edge between the affected and sound skin tissue is usually sharp or distinct, and the affected area is firm. The affected areas develop during storage at chilling temperatures and soon after removal from chilling temperatures and transfer to shelf life temperatures. However, there is little or no increase in size of affected skin areas during ripening.

The flesh is usually not affected by the skin injury unless fruit are stored for prolonged periods below the optimum storage temperature. Internal symptoms of chilling injury include gray or brown discoloration of the flesh, and uneven ripening.

There was no difference in the expression of chilling injury following storage under CA (5% O₂ + 5% CO₂) or air conditions (Fig 2). No chilling injury developed during the 2 weeks in storage other than where fruit had been pretreated at 2 °C.

Fuzzy patches

This rot symptom ('measles') develops on hard green fruit during and after storage in either air or CA, although it may be exacerbated under some CA conditions. Small water soaked spots between and around the lenticels develop and grow into larger lesions that are soft and brown (Fig. 1E). The lesions have diffuse boundaries, hence the description fuzzy patches, and a water soaked appearance. The lesion will eventually penetrate the affected skin, and cause a rot penetrating into the flesh of the fruit.

CONCLUSIONS

Low O₂ injury, chilling injury and measles have distinct symptoms, which can be used to distinguish or separate the occurrence of these disorders. All three disorders are commonly found in CA shipped avocados. Knowing the tray and pallet position in a container may also help in deciding if damage is the result of chilling or low O₂ injury. Hass avocados appear to be relatively tolerant to CO₂, although high CO₂ may affect rot occurrence because of the CO₂ effect on slowing ripening. Overall, whilst CA shipping has been extensively used, there is little or no research information specifically on the optimum CA conditions for NZ Hass avocados.

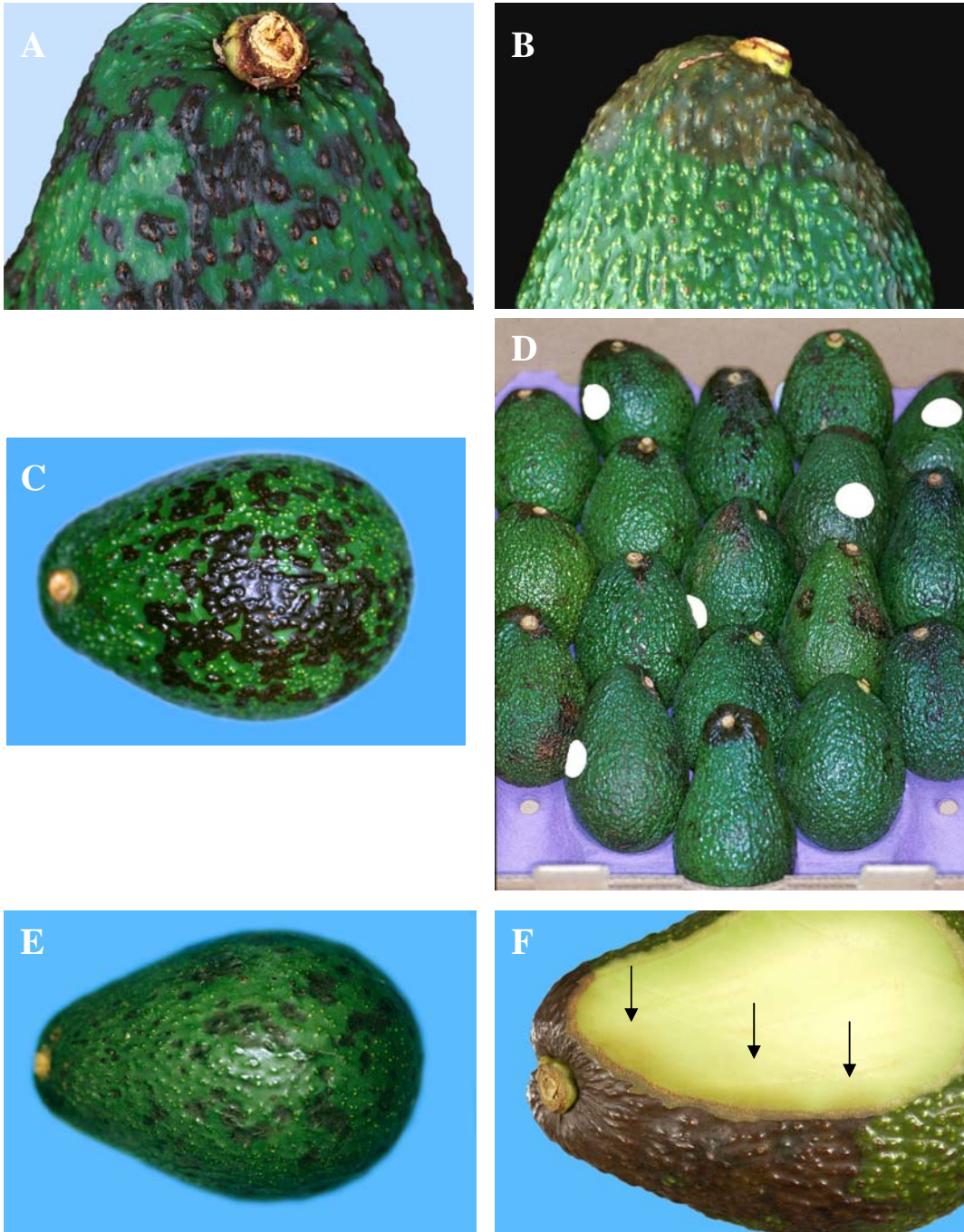


Figure 1. Symptoms of disorders developing under controlled atmosphere storage: A) chilling injury, B) low oxygen damage, C) fruit with chilling injury, D) tray of fruit with low oxygen injury, E) fuzzy patches ('measles'), F) low oxygen damage showing diffuse flesh discoloration in the region of affected skin (indicated by arrows).

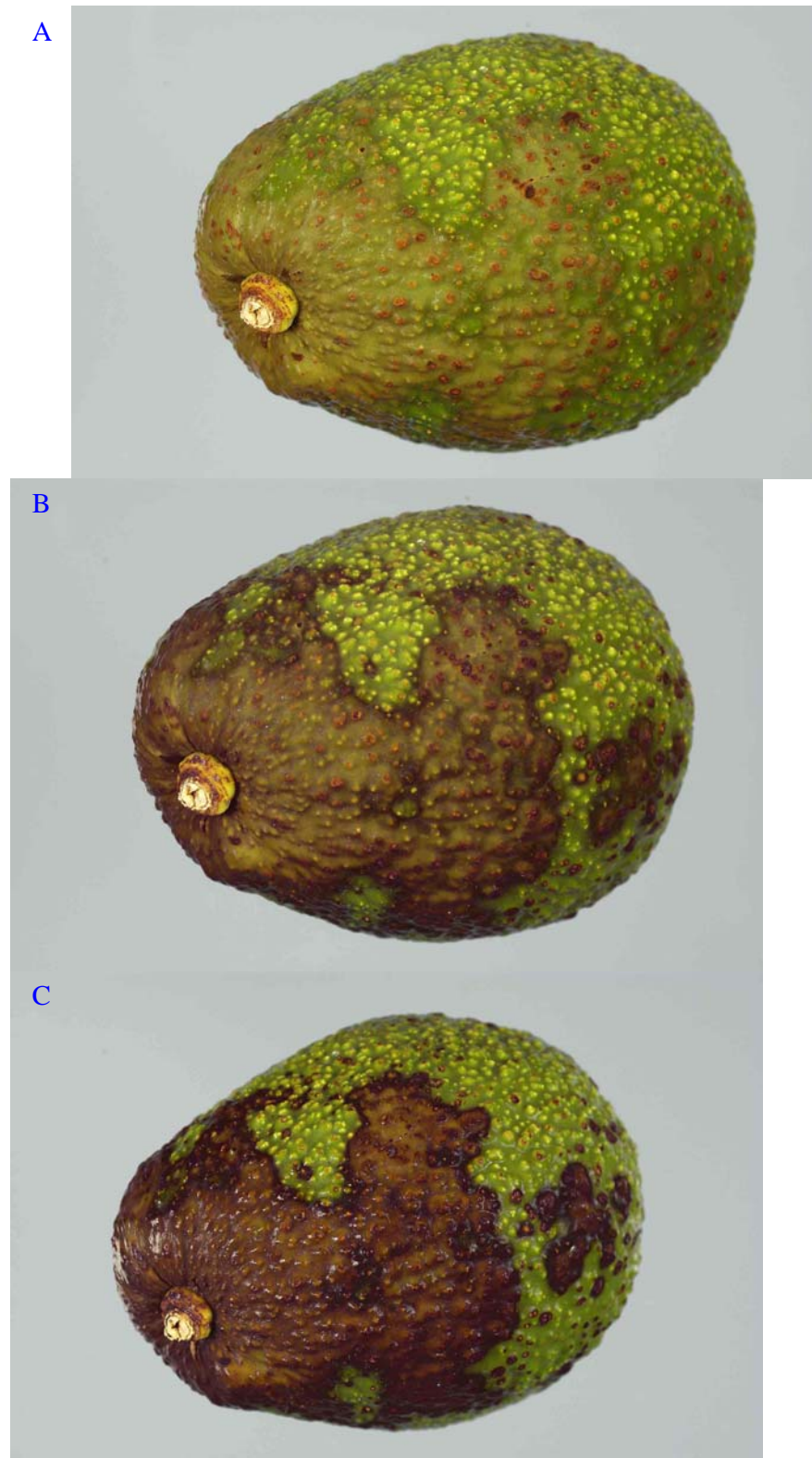


Figure 2. Development browning in fruit with low oxygen damage. Fruit were stored in a 0.1% O₂ atmosphere for 14 days. Photos were taken: A) immediately after removal to air, B) 1 hour after removal to air and C) 6 hours after removal to air.

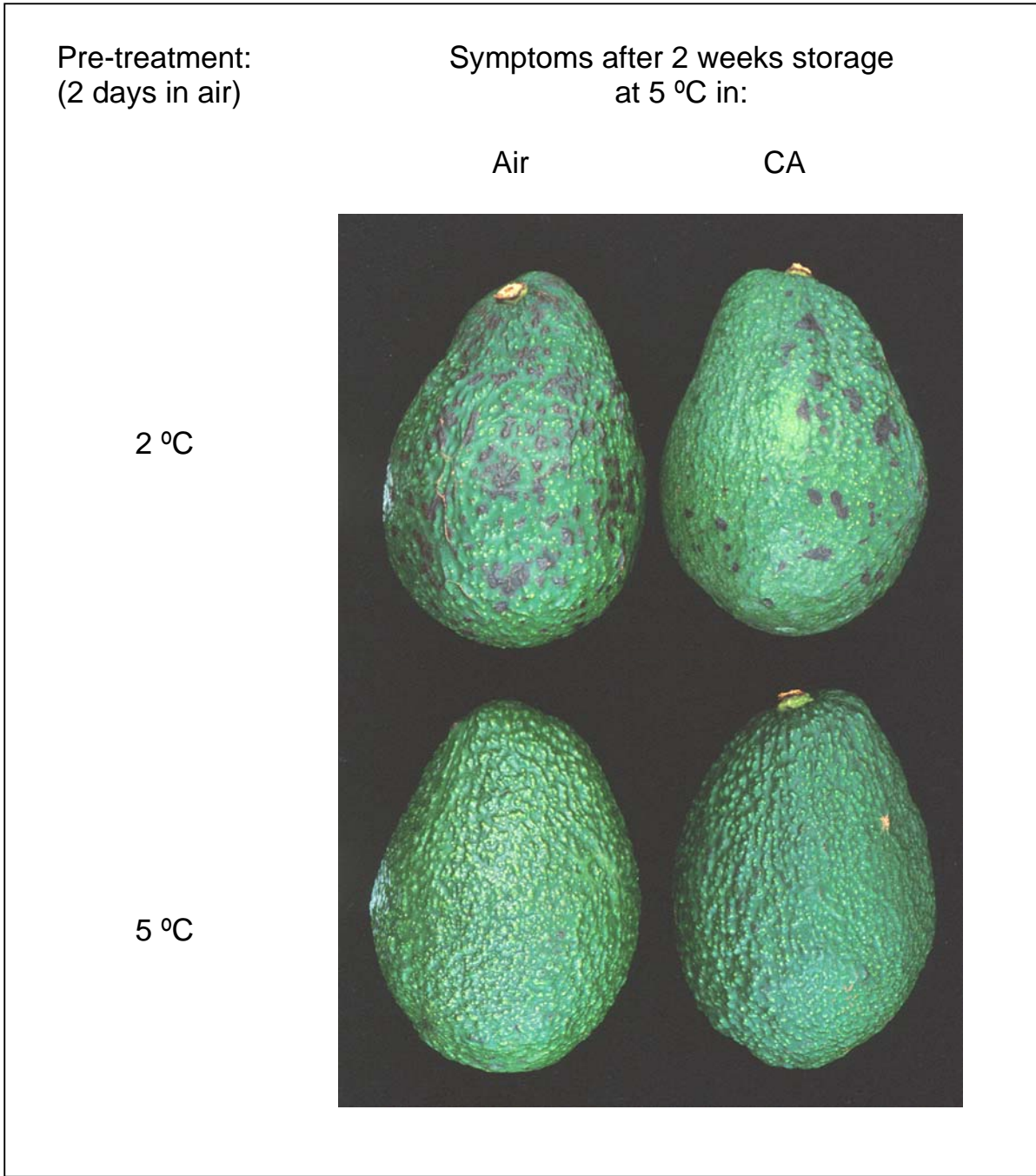


Figure 3 . Expression of chilling injury under CA and air after 2 weeks storage at 5 °C. Fruit were pretreated for 2 days by storage in air at either 2 °C or 5 °C.

