Horticulture Innovation Australia

Final Report

Physiology of onion bulbs destined for export markets

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Project Number: VN12000

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This project has been funded by Horticulture Innovation Australia Limited using the onion industry levy and funds from the Australian Government.

ISBN 0 7341 3592 0

Published and distributed by:
Horticulture Innovation Australia Limited
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Summary

The majority of Tasmania's exports are for counter season supply to Northern Hemisphere countries, with approximately 80% (>27,000t) supplied to European countries. International competition in this market from other Southern Hemisphere exporting countries such as New Zealand, South Africa and South America is strong, and ongoing access requires the Australian industry to maintain a competitive edge. Maintenance of this advantage currently hinges on the quality of bulbs upon arrival, after 6-8 weeks transit through the tropics into the European market. Shipping for this period across the equator is a point of difference between the domestic and export markets. Robust bulbs suitable for export are those that have not broken 'dormancy' and have retained both 'firmness' and skins whilst being shipped to the Northern Hemisphere in fantainers under ambient conditions.

This study developed a greater understanding of the functional processes underpinning bulb robustness. This included the role that both pre-harvest growth and development factors and post-harvest mechanical impacts play. In general, bulbs that received mechanical impacts during grading and sorting had higher respiration rates, which were linked to greater weight loss and reduced storage life. The extent to which mechanical impacts reduce storage life was further explored by controlling the number, magnitude and position of mechanical impacts to bulbs in laboratory studies. While respiration rate and sprout growth during storage was increased from greater impacts, this study provides new evidence bulbs were more sensitive to impacts to the base plate than to impacts to the equator or neck. This is the first study to report the high degree of sensitivity of the onion baseplate to mechanical impact. Furthermore, bulbs from different crops varied in storage life potential. We found that bulbs with low respiration rate prior to grading had longer storage life indicating that pre-harvest factors play an important role in determining bulb sensitivity to impacts and storage-life. This crop-to-crop variation in bulb respiration rate prior to grading provides, in part, an explanation to the differences among crops in robustness and storage life reported by industry.

The rate of bulb growth and the timing of interruption to its development (lifting for in-field curing) were investigated as possible explanations for the crop-to-crop variation in bulb robustness and storage life. The growth rate of bulbs had only a minor influence on bulb storage life, however the timing of interruption was found to be important. Lifting bulbs from the soil for curing when the foliage of between 80 and 100% plants in a crop has collapsed (termed 'tops-down') resulted in a longer storage life than lifting earlier or later stage of development. While 'tops-down' is widely used by industry as a marker to determining time of lifting, forecasting this event to schedule lifting operations is difficult, because it is not known how to predict the time at which foliage lodging begins, or the length of time to 80% tops-down. Understanding the mechanism by which an onion canopy collapses is an important prerequisite to allow predictive scheduling of lifting times. While a plant canopy may collapse under its own weight, this study showed that this does not occur until the onion neck tissues soften. A custom-built tool for quantifying the mechanical properties of pseudostem bases as a proxy for canopy collapse was designed and tested as a pre-lodging indicator of development independent of genotype and environment.

Keywords

Onion bulb, storage life, mechanical impact, maturity, lodging, canopy collapse, psuedostem