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APPLE BRUISE MEASUREMENT BY IMAGE ANALYSIS

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ABSTRACT

Apple bruising is one of the main problems causing loss of apple quality during harvesting and post-harvesting process. The degree of bruising may be described by bruise surface or volume, but manual measurement of these variables is tedious and often inaccurate. Image analysis techniques could be more accurate and reliable. This study was therefore designed as part of a project to develop a semi-automatic system to determine apple bruise size, by establishing an effective method of image analysis for measuring apple bruises in the laboratory.

Systems for image analysis of apple bruises were set up using the VIPS (Vision Image Processing System) computer language, a program developed at Massey University. Bruises on fresh and stored "Granny-Smith" apples were made using a falling pendulum, and steel and hockey balls dropped vertically in a series of experiments. Parameters such as bruise width and depth in the bruise cross-section were measured by traditional manual methods and compared with semi-automatic image analysis values. The surface bruise area was also measured by both methods. Bruise volume assessments were made both by estimation from single cross-sections and by taking several cross-sections through the bruise and measuring their thickness. In order to test repeatability of the measurement technique, apple bruises were measured by independent assessors and their results were compared with image analysis data.

Bruise width and depth measurements from a radial cross section were the same for the manual method and image analysis. Bruise volumes calculated from these two methods by assuming a geometric shape also gave similar results, regardless of the way in which

the bruise was made. However, the standard deviation of bruise volume among the replicates technique from the image analysis was half that for the manual measurement method.

Direct measurement of the bruise surface area (after skin removal) by image analysis was five times less variable than by manual measurement. The manual method, however, consistently overestimated bruise area by 10% compared with the image analysis.

An improved method to estimate bruise volume using image analysis is proposed, which does not require a geometric shape of the apple bruise to be assumed. This involves taking a series of sections parallel to the skin. This method was more amenable to image analysis techniques and appears to be more accurate than the traditional manual radial cross-section method for bruise volume assessment.