

Title An instrument for the bioyield detection and firmness measurement of apples
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Abstract

The bioyield phenomenon occurs to an apple under compressive loading, which causes initial cell failure without destroying the integrity of the fruit tissue. Force at the bioyield point is useful for nondestructive evaluation of fruit firmness. A portable instrument was developed for measuring the bioyield force of apple fruit. The instrument was tested and evaluated to determine its correlation with the standard Magness-Taylor (MT) firmness tester, measure sensitivity to changes in firmness over time, and quantify firmness variation over the fruit. Bioyield force correlated well with MT force with the R^2 values of 0.835, 0.654, and 0.751 for Golden Delicious, Red Delicious, and the pooled data, respectively. Bioyield force was as sensitive to firmness change over time as MT force ($R^2 = 0.990$) for apples that underwent accelerated softening. The bottom (the calyx end) of an apple is significantly firmer than the middle and top of the fruit. Moreover, the south face or sunny side of an apple is significantly firmer than the north face or shady side of the fruit. Firmness measurement accuracy improves when measuring opposing sides of an apple to obtain a single firmness measurement. Because bioyield measurements do not degrade the quality of a tested apple, this instrument is useful for measuring the firmness of apples in the orchard, during postharvest handling, and monitoring storage conditions.