

Title Optimal sampling strategies for evaluating fruit softening after harvest in apple breeding
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Abstract

Environmental variance components associated with year, tree, and harvest date were estimated for fruit softening after harvest in apple (*Malus × domestica* Borkh.) to determine their relative importance and design optimum sampling strategies to discriminate genotypes in apple breeding. Fruit were stored after harvest under 20 ± 2 °C and $80 \pm 5\%$ RH. Softening was evaluated by adapting the change in firmness during storage to a linear regression and defining the regression coefficient as the softening rate. Environmental variances associated with genotype \times year interaction, among trees, year \times tree interaction, and among harvest dates were all very small, namely, 2.7, 0.1, 5.2, and 5.7%, respectively, to the total variance obtained from the analysis of variance for the softening rate. The variance associated with genotype, at 57.3%, was very large. On the basis of the number of fruit necessary for firmness measurements, two times harvest is an efficient strategy to determine a genotype mean for the softening.