Abstract

The overall objective of this research was to evaluate chlorophyll fluorescence as a rapid and nondestructive indicator of postharvest stresses in apples. The effectiveness of chlorophyll fluorescence techniques to detect atmospheric, chilling and water stress in apples during storage, as well as to predict superficial scald development was investigated. Chlorophyll fluorescence was determined using either an SF-20 Plant Productivity Fluorometer (Fv = (P-T)/P; where P = P level of fluorescence and T = T level of fluorescence) or an OS-500 Modulated Fluorometer (Fv/Fm (Fv = Fm-Fo, where Fm = maximum fluorescence, and Fo = O level of fluorescence) and T1/2 (half-time for rise in Fv)). Fv and Fv/Fm decreased and T1/2 increased in apples stressed with either low O_2 (1-2%) or high CO_2 (12-20%). The effects of low O_2 or high CO_2 on Fv/Fm and T1/2 occurred after 1 d of treatment, while reductions in Fv were observed after 5 d. Fv was lower in apples chilled at 0 °C for 3 months than in fruit stored at 3 °C, but inconsistencies developed after 6 and 9 months of storage. The development of low-temperature disorders and fruit aging seemed to interfere with the fluorescence measurements. Chlorophyll fluorescence did not reflect water stress in apples, as storage humidity affected moisture loss but did not influence Fv values. Fv at harvest correlated with superficial scald development in 'Sturdeespur' Delicious apples during storage at 0 °C, but not in 'Imperial' Delicious apples. 'Sturdeespur' apples from an early harvest with low Fv were least likely to develop scald, while those with high Fv were most likely to develop severe scald. A rapid decline in Fv/Fm and T1/2 in apples during storage at 0 °C preceded scald development, but such declines also paralleled apple aging which may interfere with the efficacy of this technique. It was concluded that chlorophyll fluorescence can be a rapid and nondestructive indicator of some postharvest stresses in apples, especially rapidly-imposed stresses such as low O_2 or high CO_2 stress.