Weather Conditions during Specific Apple Phenological Stages Influence Fruit Quality at Harvest and in Storage

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### Introduction

Interannual variability in apple fruit quality at harvest and in storage is often associated with weather conditions during specific phenological stages prior to harvest. Many bioclimatic models that capture this weather variability were implemented in CIPRA (Plouffe et al. 2014), a computer system that uses real-time weather data to assist crop producers in their daily decision-making process. Bioclimatic models to assess risks associated with weather conditions are already helpful for apple producers in adjusting their storage and marketing strategies based on forecasted apple quality levels at harvest and in storage.

### Weather vs ‘McIntosh’ and ‘Empire’ Apples

Apple fruit firmness is one of the main attributes indicating fruit quality at harvest. Weather conditions during apple development are often mentioned for their impact on attributes linked to fruit firmness, i.e. fruit size, calcium concentration, water content, etc. According to Lachapelle et al. (2013a), in a study conducted in Eastern Canada, rainfall from 61 to 90 days from bloom (DFB) and air temperature from 31 to 60 DFB explained 39% and 12%, respectively, of ‘McIntosh’ apple firmness variation at harvest time (Figure 1). Using phenological periods after bloom greatly enhanced the weather based fruit firmness predictions compared to using calendar days.

Weather conditions prior to harvest also influence the incidence of many storage disorders. Growing seasons of 1992 and 2000 in Eastern Canada were characterized by lower temperatures and more days with rainfall than average during July and August. Vascular browning, a low temperature disorder observed in ‘McIntosh’ apples, caused major losses throughout storage during the following winters. Similar problems were observed for ‘Ariane’ apples in France. Low temperatures and low solar radiation from 31 to 90 DFB were associated with higher vascular browning incidence in ‘McIntosh’ apples (Bourgeois et al. 2015) (Figure 2A).

### Weather vs ‘Honeycrisp’ Apples

‘Honeycrisp’ apples show a high susceptibility to physiological disorders such as soft scald and soggy breakdown. Apple phenological data, preharvest data, and storage disorder incidences were collected over many years with the objective of identifying which weather parameters during fruit development influence soft scald and soggy breakdown incidences. Using data from three sites in Ontario, two sites in Quebec and one site in Nova Scotia for three seasons (2009–2011) and four additional sites in Ontario from 2002–2006, Lachapelle et al. (2013b) showed that low temperatures and high rainfall from 0 to 30 DFB explained 20% and 13%, respectively, of the variation in soft scald incidence in ‘Honeycrisp’ apples (Figure 4A).