Responses to Low Temperatures in Growing Buds of 'Fuji' and 'Hongro' Apple Trees in the Early Spring

Seung-Heui Kim
Department of Horticulture, Korea National University of Agriculture and Fisheries, Jeonju, Republic of Korea

Hae Keun Yun
Department of Horticulture and Life Science, Yeungnam University, Gyeongsan, Republic of Korea

Jae Hyun Lee
Department of Horticulture and Life Science, Yeungnam University, Gyeongsan, Republic of Korea

Ju Hee Song
Department of Horticulture, Korea National University of Agriculture and Fisheries, Jeonju, Republic of Korea

Abstract

The fluctuation of temperatures in early spring has increasingly resulted in poor fruit set and reduced yield and quality in apple production in Korea. This study analyzed the responses of growing buds of 'Fuji' and 'Hongro' apple trees exposed to −4°C for 3 hours to determine cultivar-specific growth limit conditions and to clarify how tree growth characteristics affect low-temperature damage. Bud injury on detached bearing branches increased markedly at the foliation stage compared to the dormant and sprouting stages in both cultivars. 'Hongro' buds were more sensitive to low temperatures at all stages than those of 'Fuji'. Buds formed on long shoots were more vulnerable than buds on short shoots with short internodes, particularly during the sprouting stage in orchards located in mountainous areas of Gyeongsangbuk-do. Additionally, buds on thicker branches with short internodes exhibited greater tolerance compared to buds on thin branches grown under similar environmental conditions. Thermographic imaging showed that surface temperature of buds changed rapidly under low-temperature exposure, and relatively cold-tolerant buds maintained higher surface temperatures. These temperature response patterns provide meaningful indicators for predicting and reducing frost damage, offering valuable information for improving management practices and maintaining stable fruit production under climate variability.

Keywords

Apple buds, low-temperature injury, cultivar difference, shoot characteristics, thermographic analysis.