Cold-tolerance screening complements agroclimatic matching in regions facing severe winter freezes. In Gansu, China, evaluation of 28 local germplasms identified large variation in semi-lethal temperature (LT50, -28.22 to -17.22 °C), with the highly resistant 'Dingjiaba Liguang Tao' showing the lowest LT50 and strong associations between cold hardiness and soluble sugars, proteins, proline, and xylem and cork anatomy. A separate comprehensive evaluation under -5°C to -35 °C stress similarly highlighted cultivars such as 'Ziyan Ruiyang' and 'Ganlu Shumi' with low LT50, high membership scores, and good field survival, providing robust parents for breeding new cold-resistant varieties and expanding resilient cultivar portfolios.

Intelligent monitoring and control systems offer powerful tools to manage orchard microclimates under increasing thermal stress. An IoT-based "smart orchard" architecture using multi-sensors (air and soil temperature, humidity, light, rainfall, wind) and LoRa transmission demonstrated reliable environmental monitoring in peach orchards with complex terrain, enabling remote supervision and providing the data backbone for temperature-focused decision support. A related multi-parameter orchard system couples sensor data to actuators (fans, pumps, LEDs, alarms) and a cloud platform + mobile interface, allowing threshold-based, remote control of the microclimate that stabilized yields, improved fruit quality, and reduced labor costs through more precise environmental regulation.

Downstream in the supply chain, AI-based decision support can optimize temperature management for quality preservation. An artificial neural network system trained on commercial cold-room data predicts the evolution of hardness, soluble solids, and acidity as functions of storage temperature, relative humidity, and time, thereby estimating optimal commercialization windows and suggesting pre-cooling setpoints that maximize the period of peak consumer-perceived quality. Insights from virtual cold-chain experiments, which identify tolerable versus harmful temperature excursions, can be integrated into such DSS tools to define safe fluctuation ranges and reduce waste while maintaining high-quality fruit delivery.

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