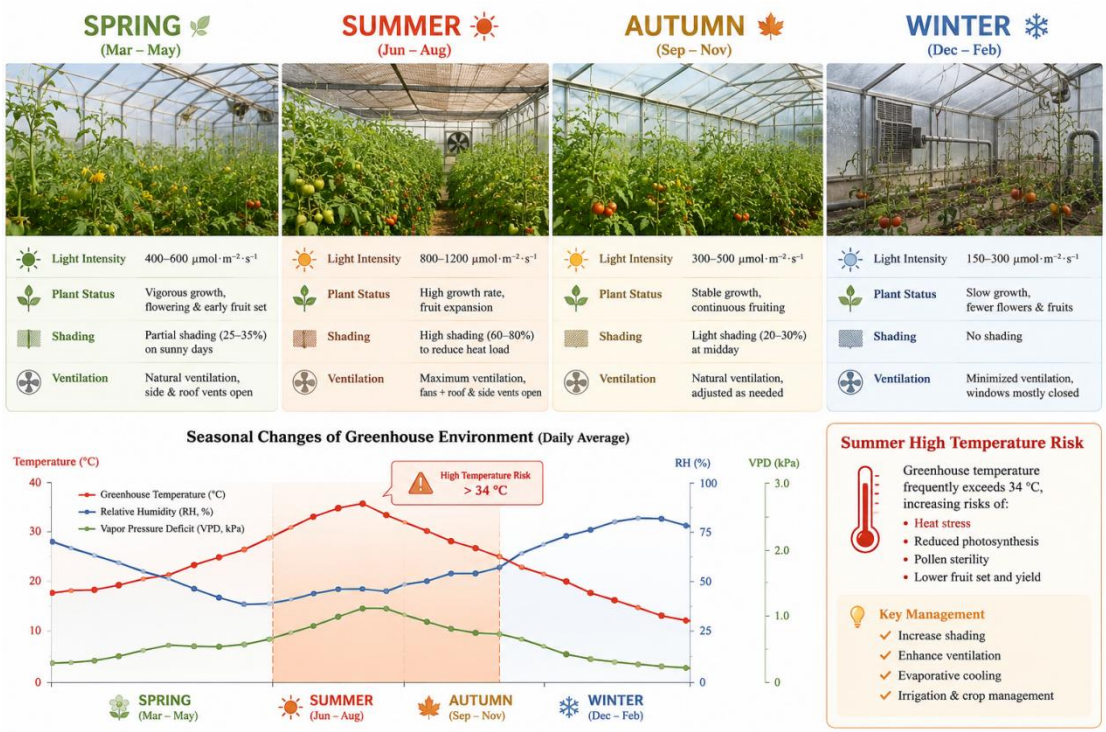

Figure 2 Seasonal variation in greenhouse tomato microclimate conditions, including temperature, relative humidity, and vapor pressure deficit across spring, summer, autumn, and winter periods

4 Tomato Yield Formation and Temperature Sensitivity

4.1 Yield components of greenhouse tomato

Tomato yield in greenhouse systems is determined by the interaction of fruit number, fruit size, and fruit dry matter content, all of which are sensitive to temperature. Yield components such as flower number, fruit set, and number of fruits per plant have been repeatedly proposed as primary markers of performance under heat, because they directly reflect reproductive success under stressful thermal regimes (Ghabileh et al., 2024). In many screening and physiological studies, genotypes that sustain higher fruit set and fruit number under high temperature also maintain higher overall yield, indicating that temperature sensitivity of these components largely controls production potential (Ro et al., 2021).

Fruit size and mass are additional key components shaping final yield. High temperature in greenhouses commonly reduces fruit weight, diameter, and firmness, with reported declines in susceptible cultivars of more than 30% in fruit weight compared with normal temperature conditions (Rajametov et al., 2021). Experimental increases of mean temperature by only a few degrees during fruit development have also been shown to reduce fruit size and alter sugar-acid balance, demonstrating that relatively small thermal shifts can reshape both quantitative and qualitative yield traits. At the same time, modeling and dry-matter studies in greenhouse tomato indicate that high yields are associated with improved total dry-matter production and efficient partitioning to fruits, suggesting that temperature effects on canopy photosynthesis and source-sink balance feed through to both fruit number and fruit size.

4.2 Critical temperature thresholds during different growth stages

Temperature thresholds governing tomato yield are strongly stage-dependent, with the reproductive phase showing the greatest sensitivity. Reviews of heat stress in tomato identify upper threshold temperatures around 30 °C-35 °C as critical for many processes, noting that temperatures above about 35 °C can inhibit seed germination, vegetative growth, flowering time and fruit set (Lee et al., 2022). In commercial protected cultivation in hot Mediterranean summers, mean daily temperatures of 25 °C-26 °C already appear to represent an upper limit for proper fruit set and yield, with even modest reductions of 1 °C-1.5 °C and higher humidity improving pollen viability and fruit set rates (Harel et al., 2014).