7.4 Pest and disease factors affecting fruit quality

Pests and diseases directly affect fruit marketability and suitability for drying. In tropical field trials, mealybug infestation and ostiole-end cracking significantly reduced fruit quality, and different cultivars showed different levels of susceptibility (Moniruzzaman et al., 2020). Fungal pathogens such as *Diaporthe* spp. can cause leaf blight, branch dieback, and fruit spot, weakening tree vigor and affecting fruit appearance (Nur-Shakirah and Mohd, 2025). In southern Italy, fig decline has been identified as a disease complex caused by multiple factors, including Botryosphaeriaceae, Fusarium species, and bark beetles, characterized by cankers, vascular discoloration, wilting, and significant yield loss (Habib et al., 2025).

8 Challenges and Future Research Directions

8.1 Limitations of current evaluation methods

At present, most evaluations mainly focus on morphological traits and fruit characteristics (such as fruit size, color, weight, and soluble solids content, SSC), as well as simple multivariate ranking. These studies are often limited to a single region or specific climatic conditions. Drying properties, postharvest performance, and storage responses are rarely integrated with field data, although cold storage studies have shown that different cultivars exhibit significant quality differences during storage (Byeon and Lee, 2020). Molecular diversity studies (such as ISSR, SSR, and iPBS) are usually not well connected with detailed fruit quality phenotyping, which limits their direct application in breeding selection (Uçer et al., 2025).

8.2 Breeding needs for dual-purpose trait improvement

Many screening studies have identified superior genotypes with large fruit size, high SSC, rich bioactive compounds, or strong drought resistance. However, these traits are rarely integrated into systematic breeding programs. Wild species, local varieties, and underutilized germplasm resources show wide phenotypic and genetic variation, and they have the potential to develop ideal dual-purpose types (for both fresh consumption and processing). However, they are mainly used for resource characterization rather than systematic hybrid utilization (Elmeknassia et al., 2025). Future breeding should not only improve fresh fruit quality but also focus on key traits such as high dry matter content, peel characteristics, ostiole size, and stress resistance (Aljane et al., 2018).

8.3 Role of genomics and phenotyping technologies

The availability of chromosome-level fig genome assemblies and the development of high-density molecular markers make it possible to link SNPs and candidate genes with traits such as fruit size, sugar content, acidity, bioactive compounds, and drought response regulatory networks (e.g., NAC transcription factor FcJA2) (Ren et al., 2025). Studies based on SSR, ISSR, and iPBS have shown high genetic diversity within populations and weak geographic differentiation, providing a strong foundation for marker-assisted selection (Qurbanova et al., 2025). Future research should combine these molecular markers with standardized and high-throughput evaluations of fruit quality, stress physiology indicators, and drying suitability.

Author Contributions

The author conducted this study, including literature review, data analysis, and the drafting and revision of the manuscript. The author has read and approved the final version of the manuscript.

Conflict of Interest Disclosure

The author affirms that this research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

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