interception patterns and intensity (Javaid et al., 2017; Haque and Sakimin, 2022). A row planting system (square or rectangular) is usually recommended, with rows oriented roughly north-south to optimize light distribution and facilitate mechanization. At the same time, a hierarchical road system (main roads and secondary paths) and drainage ditches designed along contour lines or slopes should be established to ensure rapid removal of excess surface water and prevent rill and gully erosion on slopes. Grass ditches or vegetative strips along drainage channels can further enhance soil stability and improve water quality (Simon et al., 2017).

2.4 Shelterbelt and ecological buffer zone design

Shelterbelts, as key structural components, can effectively reduce wind speed, prevent soil erosion, regulate the microclimate, and enhance habitat diversity, and have been widely recognized worldwide. Well-designed shelterbelts (considering height, width, orientation, and internal permeability) can not only increase crop yield, reduce evapotranspiration, and protect environmentally sensitive fruit crops, but also provide multiple ecosystem services, including biodiversity conservation, carbon sequestration, and air quality improvement (Weninger et al., 2021; Enescu et al., 2025).

In orchard ecosystems, artificially established shelterbelts and riparian buffer zones can also protect soil and water bodies. When tree species are well matched to site soil conditions, and combined with appropriate planting spacing and soil preparation measures, tree survival rates and growth performance can be significantly improved (Mathieu et al., 2024). For waxberry orchards located on open slopes, multi-row shelterbelts or hedgerows can be used, selecting local or well-adapted woody species and arranging them at suitable intervals based on shelterbelt height, with orientation perpendicular to the prevailing wind direction. At the same time, herbaceous ecological buffer zones should be established along field edges and around water bodies.

3 Variety Selection and Orchard Renewal

3.1 Recommendation of high-quality bayberry varieties

China has abundant bayberry germplasm resources. In recent years, genomic and phenotypic studies have clarified that different varieties show clear differences in fruit size, color, flavor, antioxidant capacity, and disease resistance (Zhang et al., 2024). At present, widely cultivated varieties such as ‘Biqi’, ‘Dongkui’, ‘Dingao’, ‘Zaojia’, as well as local elite lines like ‘SY-2’, are considered core high-quality resources due to their large fruit size, red to purple color, high soluble solids and anthocyanin content, and strong market acceptance.

‘Zaojia’ has been successfully bred as a multi-resistant variety and has been used as a reference material for high-quality genome assembly, showing its important value in both breeding and production. ‘SY-2’, a new bayberry variety selected from Dongting Mountain, shows strong tree vigor, large and round fruits (average 12.63 g), deep purple color, high soluble solids and anthocyanin content, and matures 5~7 days earlier than ‘Xiaoye Xidi’. It is considered a highly promising early-maturing high-quality variety (Dai et al., 2012). At present, multi-omics platforms such as the Bayberry Database have integrated genomic, transcriptomic, molecular marker, and germplasm resource information, which greatly promotes the precise selection and application of superior varieties in production (Jiao et al., 2012).

3.2 Matching varieties with ecological environment

In Zhejiang and Yunnan, ecological zoning based on temperature, extreme low temperature, rainfall during fruiting period, air humidity, altitude, and terrain can divide bayberry planting areas into most suitable, suitable, marginal, and unsuitable zones. Among them, regions with warm winters, humid spring and summer, and hilly or semi-mountainous terrain are the best for high-quality bayberry production. In contrast, high mountains and low-lying plains are not suitable due to higher risks of frost or waterlogging (Shou-Zhi, 2004).

Soil factors such as pH, nutrient imbalance, and salinity also significantly affect variety performance. In the southeastern coastal areas, saline-alkali soils seriously limit the growth of traditional red bayberry rootstocks. However, using wax myrtle (Morella cerifera) as a rootstock allows ‘Biqi’ to maintain good growth under high Na, Mg, and Ca conditions. It shows dark green leaves and good fruit quality, with larger fruits, higher sucrose and citric acid content, and earlier flowering and fruiting (Huang et al., 2025). Studies on dwarf and high-density