cultivation indicate that salt-tolerant wax myrtle rootstocks can promote early fruiting, improve fruit size and flavor, and adapt to saline-alkali soil conditions.

### 3.3 Grafting and variety renewal techniques

Grafting is a key technique for rapid renewal of bayberry varieties. It allows the combination of high-quality scions with rootstocks that have better adaptability or stress resistance, and also helps renew old orchards. From physiological and molecular perspectives, grafting can shorten the juvenile phase, regulate tree vigor and canopy structure, increase yield, and enhance resistance to soil stress and pathogens (Williams et al., 2021; Habibi et al., 2022; Loupit et al., 2023). Successful grafting depends on coordinated hormone regulation (such as auxin, cytokinin, ethylene, gibberellin, abscisic acid, and jasmonic acid), wound healing, vascular reconnection, and compatibility between rootstock and scion at physiological and molecular levels.

In practice, techniques such as cleft grafting, bark grafting, and top grafting are commonly used to replace inferior or mixed varieties with uniform high-quality ones, thus shortening the fruiting period and improving orchard uniformity.

Grafting ‘Biqi’ onto wax myrtle rootstock in saline-alkali soil shows good graft compatibility, normal growth, and excellent fruit quality, indicating that proper rootstock-scion combinations can effectively utilize marginal land (Huang et al., 2025). With the development of SSR markers, high-density SNP genotyping, and telomere-to-telomere (T2T) genome technologies, it is now possible to systematically screen rootstock-scion compatibility and rootstock effects, thereby shortening the breeding and evaluation cycle of new combinations.

## 4 Soil and Fertilization Management Measures

### 4.1 Annual fertilization regime (basal fertilizer, topdressing, and post-harvest fertilization)

Long-term investigations in red soil orchards have shown that imbalanced fertilization and declining soil organic matter are closely related to problems such as weakened tree vigor, smaller fruit size, and unstable yield (Zhuang et al., 2024). The annual fertilization regime for waxberry should align nutrient supply with phenological stages, while combining quick-acting mineral nutrients with slow-release organic nutrient sources.

In field trials on weakened waxberry trees, during key growth stages—flower bud differentiation and new shoot emergence—compound fertilizer (NPK 15-15-15) and bio-organic fertilizer (based on sheep manure) were applied in trenches near the canopy drip line and then covered with soil (Ren et al., 2021). Compared with the unfertilized control, this fertilization timing significantly improved vegetative growth, fruit traits, and the physicochemical properties of rhizosphere soil.

### 4.2 Combined application of organic fertilizers and green manure

Livestock and poultry manure, compost, cover crops, and other organic amendments can improve soil structure, increase organic carbon content, and enhance microbial and enzyme activities. They also often improve fruit quality traits such as sugar content and antioxidant capacity (Chatzistathis et al., 2021; Dhaliwal et al., 2023).

In waxberry studies, bio-organic fertilizer based on sheep manure significantly increased exchangeable calcium and magnesium, as well as available phosphorus and potassium in the soil. At the same time, it reshaped the rhizosphere microbial community and metabolite composition, which were closely associated with the alleviation of decline disease and improvement of tree health (Ren et al., 2021).

Returning green manure to the field, combined with balanced chemical fertilization, can significantly increase soil organic carbon and its active fractions, total nitrogen content, and enzyme activities. It can also increase the yield of the following crop by 34%-53%, while reducing soil bulk density and slightly lowering soil pH (Xu et al., 2023).

### 4.3 Soil testing and precision fertilization

Precision fertilization for waxberry should begin with diagnosing soil limiting factors, such as strong acidity, low organic matter content, and imbalances in nutrients like phosphorus, potassium, calcium, and magnesium. Based