

3 Cultivation Management Models

3.1 Conventional management: high-input practices, strengths, and drawbacks

Conventional management mainly relies on a large amount of chemical fertilizers, pesticides and water management, with the aim of pursuing high yields and stable fruit quality. Under this model, Changshan Huyou grows well in a suitable environment, with relatively stable yield and flavor, few pests and diseases, and easy control. Therefore, it has good economic and ecological value (Tan et al., 2012). However, this high-investment approach will also bring environmental pressure, consume resources and may even lead to soil degradation. Excessive reliance on chemical inputs may also affect the safety and market competitiveness of fruits.

3.2 Ecological and organic management: sustainability and product differentiation

Ecological and organic management places greater emphasis on reducing the use of chemicals, focusing on soil health, biodiversity and ecological balance. In suitable regions, Changshan Huyou can also achieve high yields and quality through ecological management, and enhance the ecological value and market differentiation advantages of the fruit (Tan et al., 2012). Organic management can reduce the occurrence of pests and diseases, increase the safety and added value of fruits, and make them more competitive in the high-end market. However, this model has high technical requirements, is more sensitive to environmental adaptability, may have a slightly lower output, and is easily affected by climate and soil conditions (Yu et al., 2012).

3.3 Integrated and precision management: technology-driven approaches (smart irrigation, nutrient management, digital monitoring)

Integrated and precision management combines new technologies such as intelligent irrigation, nutrient regulation and digital monitoring. By collecting data on meteorology, soil and crop growth in real time, irrigation and fertilization schemes can be optimized, resource utilization can be improved, and adaptability to extreme climates can be enhanced, thereby maintaining the stability of yield and quality (Yu et al., 2012; Yan et al., 2021). This approach can achieve efficient and sustainable production, but it requires a high level of technology and management, and is more suitable for large-scale and modern planting.

4 Effects on Yield Performance

4.1 Yield comparison among different cultivation models

Different cultivation and management methods will significantly affect the yield of Changshan Huyou. Research has found that reasonable management measures, such as dense planting, pruning, integrated water and fertilizer management, and comprehensive pest and disease control, can significantly increase the yield and commercial quality of citrus fruit trees. In the introduction adaptability test, Changshan Huyou showed good growth momentum, high yield, stable fruit flavor, few and easy-to-control diseases and pests under suitable climate and management conditions, demonstrating strong adaptability and promotion value. Among them, dense planting and scientific pruning can increase the yield per unit area, while precise water and fertilizer management can further enhance fruit quality and yield stability (Tan et al., 2012). Compared with the traditional extensive management, the efficient and integrated management model can simultaneously increase output and quality.

4.2 Factors influencing fruit set, maturation, and stability of annual production

The main factors influencing the fruit setting rate, maturity and annual yield stability of Changshan Huyou include: climatic conditions (temperature, precipitation, light), soil fertility, variety characteristics, cultivation density, pruning methods, water and fertilizer management and pest and disease control. Suitable climate and soil are conducive to flower bud differentiation and fruit development. Scientific water and fertilizer management can promote fruit enlargement and improve quality. Reasonable pruning can improve the structure of the tree, enhance ventilation and light penetration, reduce the occurrence of pests and diseases, and thereby increase the fruit setting rate and fruit uniformity. Integrated pest and disease control can also ensure the normal development and stable yield of fruits (Tan et al., 2012). In addition, the genetic characteristics of the variety itself can also affect its adaptability to environmental stress and yield stability.

4.3 Long-term yield sustainability and orchard productivity trends

In the long term, scientific management methods are conducive to enhancing the sustained output and overall productivity of Changshan Huyou orchards. Continuous optimization of water and fertilizer management,