

Intensive Planting and High Yield Cultivation Techniques for Yuluxiang Pear in Hilly and Mountainous Regions

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Abstract In order to enhance the guidance for Yuluxiang pear cultivation in hilly and mountainous regions, this study provides a comprehensive introduction to various aspects, including the establishment of high-standard orchards and the reinforcement of integrated management techniques, in order to offer a valuable reference for fruit farmers engaged in scientific planting practices.

Key words Yuluxiang pear, High yield, Intensive planting, Cultivation

1 Introduction

Yuluxiang pear is a high-quality, precocious variety of pear that has been hybridized by the Institute of Pomology at the Shanxi Academy of Agricultural Sciences. This new variety is derived from the Korla fragrant pear as the female parent and the snowflake pear from Zhaoxian County as the male parent. It is characterized by its resistance to drought, cold, yellowing, and various diseases^[1]. In Huludao City, the fruit reaches maturity between middle to late September, exhibiting an average weight of 250 g and a maximum weight of 600 g. The fruit is characterized by a subglobose shape. The pericarp displays a yellowish-green hue, accompanied by local reddish or dark red longitudinal stripes. The fruiting points are small, dense, and inconspicuous, while the surface of the fruit is glossy and possesses a waxy texture^[2]. This variety is characterized by its ease of flowering, although it produces a minimal amount of pollen and is self-sterile, necessitating the establishment of a pollination tree. In the autumn of 2014, Huludao Lingyun Agricultural Development Co., Ltd. introduced 60 000 annual seedlings of the Yuluxiang pear from Shanxi. Subsequently, in the spring of 2015, a demonstration garden for the Yuluxiang pear, covering an area of 20 hm², was established. After several years of meticulous management, significant economic benefits have been realized.

2 Overview of the demonstration garden

The demonstration garden is situated in Zhaojiagou Village, Gaoqiao Town, Nanpiao District, Huludao City. It is positioned on hilly slopes characterized by yellow clay soil, which has an approximate thickness of 60 cm. The area contains a significant quantity of both large and small stones, and the soil is notably compacted. In 2015, the year preceding the establishment of the garden, the soil was enhanced through the excavation of planting trenches, which were subsequently filled with sandy loam. Additionally, substan-

tial quantities of organic fertilizer and straw were applied to further improve soil quality. The mean annual temperature was 9.8 °C, with a frost-free period lasting 184 d. The total hours of sunshine amounted to 2 544.2 h, while the annual precipitation measured 600 mm. The planting spacing was established at 0.8 m, the row spacing at 3.5 m, and the planting density was calculated to be 3 570 plants/hm². Fruiting commenced in the third year following planting (2017), yielding 12.45 t/hm²; 33 t/hm² in 2018; and 52.5 t/hm² in 2019, resulting in a cumulative production of 1 050 t. The average selling price was 6.00 yuan/kg, leading to an output value per unit area of 315 000 yuan/hm², with a total output value amounting to 6.3 million yuan.

3 High-standard gardening techniques

3.1 Land preparation To facilitate mechanized operations, the land should be graded into a gentle slope by excavating the elevated areas and filling in the depressions, with planting conducted in north-south oriented rows. One year prior to planting, a planting ditch measuring 80 cm in both depth and width should be excavated. This ditch is subsequently filled with well-decomposed sheep manure and crushed straw, with an application rate exceeding 90 m³/hm² for each material. Following the filling of the ditch, ridges are constructed on both sides to ensure adequate water retention and to allow for the proper sinking of the ditch.

3.2 Seedling selection and treatment One day prior to planting, the roots should be submerged in a pool of water for 24 h. The bud holes of all branches located 60–120 cm from the interface are meticulously carved. Specifically, a knife is employed to create a semi-circular incision approximately 0.5–0.8 cm above the bud holes, extending deep into the xylem. Subsequently, the roots are immersed in a rooting powder solution before the seedlings were planted.

3.3 Rational allocation of pollination trees To enhance the fruiting rate and ensure stable, high-yield, high-quality, and efficient production, Zaosu pear and Xueqing pear, which exhibit a greater quantity of pollen, a more consistent flowering period compared to Yuluxiang pear, and a high economic value, are selected

as pollination trees. These are configured at a ratio of 4 : 2, meaning that for every four rows of Yuluxiang pear, two rows of pollination trees are planted.

3.4 Colonization The planting locations are established with a spacing of 80 cm. The critical factors for successful planting include delayed planting and shallow planting techniques. Delayed planting is initiated when the soil temperature reaches 6 – 7 °C, and the air temperature ranges from 15 to 16°C. Shallow planting involves utilizing moist, prepared surface soil to securely position the root system of the seedling, ensuring that the grafting union remains above the soil surface. It is important to avoid excessive soil coverage. Soil cultivation is succeeded by flooding and settling to enhance the survival rate of the planted seedlings. Following the planting process, a wooden pole is installed every 10 m along the row to provide support for the seedlings.

3.5 Plastic film cylinder tubes After the seedlings are planted, they are securely encased in plastic film cylinder tubes, which extend from the top of the seedlings down to the ground. The plastic film cylinder tubes are then tied with three to four lines to prevent displacement due to wind. The seedlings are subsequently affixed to the cross ties of the uprights. When the temperature within the tube reaches 30 °C, fresh air is introduced to lower the temperature and prevent sunburn. If the temperature exceeds 35 °C, the tube is elevated.

3.6 Groundcloth Groundcloths serve multiple functions, including the moisturization of soil, the enhancement of ground temperature, the prevention of weed growth, and the facilitation of water-efficient drip irrigation. A 60 cm wide black groundcloth should be positioned on each side of the pear tree, with the edges and the central seam firmly secured with soil. Care is taken to avoid excessive compaction of the soil in order to maintain a maximum area for light exposure.

4 Integrated management

4.1 Tree shaping The trees are cultivated in a main stem type form, featuring approximately 26 primary branches that are arranged in a spiral pattern around the central stem. The diameter of these primary branches is regulated to be no more than one-third of the diameter of the central trunk, while their length is maintained at a maximum of 60 cm. The erect branches and water sprout located at the rear of the tree are meticulously regulated. With the exception of the central stem, all other branches remain unpruned, and the overall height of the tree is maintained at a maximum of 3.5 m^[3]. Buds located below 60 cm from the main stem are removed, and competing branches situated near the branch head of the central stem are pruned. When the length of new shoots from the central stem exceeds 30 cm, these new shoots are promptly positioned at an angle of 80° – 90°.

4.2 Fertilizer and water management When the yield of an individual plant attains 20 kg, the base fertilizer is applied in mid-

dle September. A fertilizer furrow, approximately 40 cm wide and 40 cm deep, is created adjacent to the original planting furrow, with the quantity of fertilizer applied exceeding 90 m³/hm². Depending on the soil's drought conditions following the application of fertilizer, irrigation using a micro-spray system may be employed. Once the leaves have largely developed, it is recommended to spray the trees every 7 – 10 d with a 500 times dilution of 0.3% urea combined with photosynthesis micro-fertilizer. From late October to early November, prior to the onset of soil freezing, the entire garden becomes saturated with water, resulting in a depth of over 70 cm of drip irrigation within the tree trays.

4.3 Fruit management Due to the extensive size of the garden and the relatively concentrated flowering period, the pollination of the fruit trees primarily relies on bees. Prior arrangements have been made with large-scale beekeepers, who will transport beehives to the garden prior to the onset of flowering. Consequently, all major flowering fruit trees will be pollinated by these bees. Meantime, a solution of 0.2% urea and 0.3% borax is applied to enhance the fruiting rate. The thinning of flowers and fruits should be assessed based on the specific tree variety to optimize fruit production, with the yield maintained at approximately 52.5 t/hm². This corresponds to retaining between 60 and 70 fruits per plant. In years characterized by abundant flowering, one inflorescence is retained at intervals of 25 cm, while the remaining inflorescences are selectively thinned. Fruit thinning commences in middle June annually, with one pendulous fruit being preserved every 20 cm, and all other fruits being removed. Fruit bagging typically commences one week post-flowering, specifically when the fruit diameter exceeds 2 cm, with a preference for the use of film bags. It is advisable to minimize the duration of the bagging process for optimal results.

4.4 Pest control Common diseases and pests include ring rot, dry rot, scab, anthracnose, black spot, borer, aphids of pear branches and fruits, *etc.* Following the fruit harvest and prior to the germination of the fruit tree, it is essential to remove the old bark along with any nymphs, as well as to eliminate diseased and infested branch tips, fallen leaves, and affected fruits. These materials should be either deeply buried or incinerated to prevent the spread of disease and pests. Prior to and following the hibernation period, a 1 000 times solution of phoxim is applied to the ground to manage pests such as the pear heartworm and the pear fruit sawfly. Additionally, approximately 2 weeks before germination, the entire garden is treated with a single application of lime sulfur at a concentration of 3 – 5 °Be. During the growing season, it is essential to safeguard the leaves utilizing a 200-fold Bordeaux mixture or a 600-fold solution of carbendazim or chlorothalonil, among other treatments, to prevent and manage pear scab, anthracnose, and related diseases. In the event of a significant aphid infestation, an additional application of imidacloprid WP at a dilution of 1 500 times may be administered. For gardens that experienced severe heartworm infestations in the previ-

ous year, pyrethroid insecticides (*e. g.* , sumicidin) at a dilution of 3 000 times may be applied. If leaf-eating caterpillars are detected, a solution of 48% chlorpyrifos at a dilution of 1 200 times can be utilized. It is imperative to cease the application of any pesticides 20 d prior to harvesting.

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