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Experimental Study on Cultivation Model of High-stem Rose in High Altitude Area

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Abstract: Through investigation and research on the development prospects of high-stem roses, the purpose and significance of conducting research on the cultivation model of high-stem roses are proposed. Taking the Xiaolongshan Forest Area in Gansu Province as an example, four sets of control data were obtained by adopting different cultivation models with different altitudes, environmental conditions, planting stake times, and grafting times in the Yushu Forest Farm. Through comparative analysis of experimental data on the cultivation model of high-stem roses in high-altitude areas, the main and secondary factors affecting the survival of high-stem rose grafting were verified, and it was determined that different altitudes are the main factors affecting the survival of high-stem rose grafting. Finally, a practical technology suitable for grafting and cultivating high-stem roses in high-altitude areas was summarized, which has high application value in the development and utilization of understory resources and urban and rural greening.

1. Development Prospects of High-Stem Roses

In recent years, with the further advancement of urban greening and rural revitalization strategies, high-stem roses have become important floral resources for road, park, and courtyard greening, with a large market demand. They are extensively cultivated in central and northern China, including Henan, Shandong, Anhui, Shanxi, Shaanxi, Gansu, and other regions. According to surveys, cultivation techniques in Nanyang, Henan, and Hanzhong, Shaanxi, are relatively mature. However, due to the limited resources of rootstock (wild roses), development is severely restricted. The forest area of Xiaolongshan in Gansu Province covers an area of 12.435 million mu, with more than 2,800 species of wild plants[1], including over 30 species of woody plants in the Rosaceae family, widely distributed with numerous populations. Most wild roses in the Xiaolongshan forest area climb in the canopy of the forest and are targets for forest nurturing and management. Reasonably and scientifically digging and excavating wild roses as rootstocks for grafting roses[2] not only achieves the purpose of nurturing forests but also realizes the goal of developing and utilizing forest resources.

2. Significance of Conducting Experimental Research

Since 2020, the Yushu Forest Farm in Xiaolongshan has continuously cultivated high-stem roses for three years. Due to inadequate control of factors such as altitude, climate, and technology, the

grafting survival rate was 87.6%, with a preservation rate of only 82.4% over three years, a crown formation rate of 72.1%, and a finished product rate of 61.5%. This severely affected the economic benefits. In April 2023, the forest farm organized professional and technical personnel to conduct investigations and research in places such as Nanyang, Luoyang, Zibo, and Hanzhong, analyzing that the main reasons were differences in altitude and climate. In order to solve these problems, the forest farm must organize comparative experimental research on different cultivation models.

3. Comparative Experimental Research on Different Models

Surveys indicate that the altitude for cultivating high-stem roses ranges from 200 to 400 meters, while the altitude of the Yushu Forest Farm's cultivation base is 1300 meters. Therefore, the forest farm conducted multiple sets of comparative experiments.

3.1 Comparative Experiment on Cultivation Models at Different Altitudes

Using the same time frame and measures, 12 controllable temperature, humidity, and light plastic greenhouses were established at three locations to conduct comparative experiments on different altitude cultivation models, as shown in Table 1.

Table 1: Comparative Experiment on High-Stem Rose Cultivation at Different Altitudes

Cultivation Location	Altitude (meters)	Number of Grafted Plants	Survival Rate (%)	Number of Scions	Scion Survival Rate (%)	1-Year Survival Rate of Plants (%)	1-Year Survival Rate of Scions (%)	Formation Rate of 3 Scions (Crown Formation Rate) (%)
Yushu Forest Farm	1520	3000	90.4	9621	85.2	87.3	81.3	77.4
Yanba Forest Farm	1300	3500	92.1	10879	88.4	87.9	84.6	79.8
Liulin Forest Farm	803	3600	98.5	11042	93.2	95.6	91.8	85.6

The results indicate that the survival rate of high-stem roses grafted in low-altitude areas is higher.

3.2 Comparative Experiment on Cultivation Models under Different Environmental Conditions

Table 2: Comparative Experiment on High-Stem Rose Cultivation under Different Environmental Conditions

Lowest Temperature (°C)	Soil Type	Ventilation and Sunlight Conditions	Number of Grafted Plants	Survival Rate (%)	Number of Scions	Scion Survival Rate (%)	1-Year Survival Rate of Plants (%)	1-Year Survival Rate of Scions (%)	Formation Rate of 3 Scions (Crown Formation Rate) (%)
-15	Sandy Soil	Half-shaded, sheltered from wind in the valley	100	91.2	300	86.7	89.1	82.6	80.3
-11	Loam Soil	Half-shaded, sheltered from wind by leaning on the mountain	100	92.9	300	89.3	90.0	84.8	82.6
-4	Sandy Loam Soil	Sun-facing, sheltered from wind by wall	100	99.1	300	95.6	97.2	93.5	91.0

Using the same timeframe and measures, 100 grafts were selected at different locations with varying temperatures, soil types, and ventilation conditions. Each graft had three scions, and three cultivation models were compared, as shown in Table 2.

The results indicate that the highest survival rate of high-stem roses grafted in sand-loam soil, in places sheltered from wind and facing the sun, with small seasonal temperature differences and relatively high minimum annual temperatures. Conversely, the lowest survival rate occurred in areas with large seasonal temperature differences, relatively low minimum annual temperatures, sandy soil, and cold, shaded places without wind protection.

3.3 Comparative Experiment on Cultivation Models with Different Planting Stake Times

Using the same location and measures, different times for digging and transplanting rootstocks (planting stakes) were selected. Each graft had 100 plants with three scions, and four cultivation models were compared, as shown in Table 3.

Table 3: Comparative Experiment on High-Stem Rose Cultivation with Different Planting Stake Times

Planting Stake Time	Late September	Late November	Mid-December	Early January
Number of Grafted Plants	100	100	100	100
Survival Rate (%)	94.2	92.3	91.6	99.7
Number of Scions	300	300	300	300
Scion Survival Rate (%)	92.6	89.7	88.2	96.3
1-Year Survival Rate of Plants (%)	92.5	90.4	89.2	97.5
1-Year Survival Rate of Scions (%)	91.2	87.3	85.4	96.3
Formation Rate of 3 Scions (Crown Formation Rate) (%)	86.2	83.8	81.8	95.3

The results indicate that in late September, when the wild roses have shed their leaves and stopped growing, and the temperature is relatively high, the survival rate of high-stem roses grafted at this time is higher.[3] In late November and mid-December, the soil in the region is frozen, resulting in poor contact between the transplanted rose rootstocks and the ground, leading to the lowest survival rate. However, in early January, when the rootstocks are transplanted, it coincides with the onset of spring, resulting in the best contact with the ground and the highest survival rate of high-stem roses grafted at this time.

3.4 Comparative Experiment on Cultivation Models with Different Grafting Times

Table 4: Comparative Experiment on High-Stem Rose Cultivation with Different Grafting Times

Planting Stake Time	Early January	Early January	Early January
Grafting Time	Early March	Mid-February	Early January
Number of Grafted Plants	100	100	100
Survival Rate (%)	90.4	92.7	99.8
Number of Scions	300	300	300
Scion Survival Rate (%)	88.6	89.3	98.4
1-Year Survival Rate of Plants (%)	90.1	90.8	98.2
1-Year Survival Rate of Scions (%)	91.2	87.3	97.5
Formation Rate of 3 Scions (Crown Formation Rate) (%)	86.3	87.4	96.9

Using the same location and measures, different times for grafting roses were selected. Each graft had 100 plants with three scions, and three cultivation models were compared, as shown in Table 4.

The results indicate that timely grafting of roses after transplanting the rootstocks, combined with measures such as grafting paint and wrapping, prevents moisture loss from the rootstock cutting site and promotes rapid callus formation. At this time, the survival rate of high-stem roses grafted is the highest.

3.5 Other Factors Affecting the Survival of High-Stem Roses

In addition to the factors reflected in the comparative experiments mentioned above, many other factors are closely related to the successful grafting of high-stem roses, such as moisture, light, warmth, ventilation, fertility, weed control, soil loosening, bud rubbing, flower pruning, as well as planting depth, and time of removal from the greenhouse. During the cultivation process, we observed, recorded, and analyzed to compile the best practices.[4]

4. Comparative Experiment Research Results

Through comparative experimental research, the following conclusions were drawn: the grafting and cultivation of high-stem roses are suitable for greenhouse cultivation, with controlled water, fertilizer, and temperature, high ridge planting, altitudes below 1000 meters, selecting sites sheltered from wind and facing the sun, with annual minimum temperatures above -5 ℃, sandy loam soil. In addition, it is necessary to transplant rootstocks in early January, graft while plant, wrap grass rope around piles, timely wipe buds and pick flowers, scientifically loosen soil and weed, transplant in the shed the following spring, prune before sprout.

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