

Key Technologies and Misconceptions in the Renovation of Low-yielding Tea Plantations in Sichuan

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Abstract This paper systematically analyzes the causes of low-yielding tea plantations and compares the applicable conditions and key technical points of three renovation methods: deep pruning, heavy pruning, and stumping. It focuses on elucidating the key technical system for renovating low-yielding tea gardens by means of heavy pruning, covering pruning time (from late April to late May after spring tea harvest), pruning height (50–55 cm above ground), soil fertilization and management, pest and disease control, canopy management, tipping and leveling, and subsequent plucking management. In addition, common technical misconceptions in production, such as arbitrary pruning height and neglect of supporting measures, are dissected. This technical system has been demonstrated and verified over years in the Sichuan tea region, it can achieve the desirable outcome of "renovation in the current year and effectiveness in the spring tea of the following year," thus providing a scientific basis for the transformation and upgrading of low-yielding tea plantations.

Key words Low-yielding tea plantation, Transformation of tea plantation, Renovation technologies for low yield, Key technologies, Sichuan Province

0 Introduction

Sichuan is a major tea-producing province, the birthplace of the tea plant and the cradle of tea culture, and is also designated as a national advantageous zone for high-quality green tea and export tea in the upper-middle reaches of the Yangtze River. With great attention from the Provincial Party Committee and the Provincial Government, the tea industry in Sichuan has achieved leapfrog development, with both planting area and output ranking among the top three in China, serving as a pillar industry for consolidating poverty alleviation achievements in the mountainous areas around the Sichuan Basin. In 2025, the province's tea garden area remained stable at 393 334 ha, with the area under productive tea gardens reaching 356 667 ha, and the total output of rough tea reached 477 000 t, an increase of 5.1% over 2024; the output value of rough tea exceeded 44 billion yuan, a year-on-year growth of 2.3%. According to incomplete statistics, the cumulative area of renovated low-yielding tea gardens during the 14th Five-Year Plan period exceeded 120 000 ha. As the area of productive tea gardens continues to expand, new low-yielding tea gardens will also keep emerging; therefore, renovation technologies for low-yielding tea gardens have broad application and sustained demand across the tea-growing regions. In actual production, the renovation practices adopted by different tea farmers vary greatly, resulting in uneven renovation effects. Consequently, a scientifically standardized renovation technique for low-yielding tea gardens is of great significance for all tea-growing areas. The authors have been continuously conducting demonstration work on renovation technologies for low-yielding tea gardens in various tea regions, and here

we summarize the relevant experiences, hoping to provide useful help and guidance for tea farmers when they carry out renovations.

1 Concept of low-yielding tea plantations

Low-yielding tea plantations refer to productive tea plantations that exhibit low yield and poor quality due to a combination of factors, including aging of tea plants, prolonged plucking, inadequate management, soil nutrient depletion, and severe pest and disease infestation.

2 Causes of low yield

The formation of low-yielding tea plantations can be attributed to the following five main causes: firstly, excessive plant age, in particular, tea plantations established in the 1960s and 1970s have surpassed the effective economic lifespan of tea plants (40–50 years); secondly, prolonged plucking, as continuous harvesting over many years leads to the weakening of productive branches on the plucking surface, forming "chicken-claw branches" that produce weak, small, and poor-quality buds and leaves; thirdly, poor management, especially in tea plantations that have not been fertilized for many years, resulting in severe soil nutrient depletion and consequently either sparse or excessively dense and weak productive branches on the plucking surface, and fewer buds and leaves; fourthly, inadequate formative pruning, where improper execution during the three-step formative pruning process leads to sparse productive branches and low yield; and fifthly, severe pest and disease damage, as heavy infestation weakens plant vigor, and the sprouts that emerge are small, weak, and of inferior quality.

3 Renovation methods for low-yielding tea plantations

For low-yielding tea plantations caused by different factors, appropriate canopy renovation measures and supporting techniques should be adopted according to the actual conditions, so as to de-

Received: June 16, 2026 Accepted: August 20, 2026

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velop new framework branches and a new plucking surface, rejuvenate plant vigor, and ultimately achieve the goal of reshaping the canopy into a high-quality and high-yielding one.

3.1 Deep pruning When the canopy, due to repeated plucking and light pruning over multiple seasons, develops increasingly weak branches and produces small, dense, and feeble buds and leaves, or even forms chicken-claw branches, deep pruning can be adopted as a renovation measure. The pruning is usually carried out at a height of 10–15 cm above the plucking surface, with the extent of pruning being sufficient to remove all chicken-claw branches^[1]. Deep pruning can effectively restore plant vigor, enabling the newly regenerated productive branches to become thicker and more uniform compared with those before pruning, thus enhancing bud-bearing capacity and significantly improving both yield and quality. Meanwhile, deep pruning is often accompanied by cleaning the stump and exposing the base, as well as edge pruning^[2–4]. Cleaning the stump and exposing the base involves using pruning shears to remove all pest-infested, diseased, overly vigorous, dead, and aged branches from the inner and lower parts of the canopy, thereby improving ventilation and light penetration within the tea plantation and promoting healthy growth. Edge pruning refers to the use of shears or a single-operator pruning machine to cut off the interlacing branches between rows, maintaining an inter-row spacing of approximately 20 cm to form a convenient passageway for operation. This not only improves ventilation and light penetration between rows but also deteriorates the microenvironment conducive to pest and disease proliferation.

3.2 Heavy pruning When, after many years of plucking, light pruning, and deep pruning, the bud-bearing capacity of the upper branches of tea plants continues to decline, and even with enhanced fertilization and management, little improvement can be achieved, still manifesting as insufficient bud-bearing capacity, small and weak buds and leaves, an increased proportion of opposite leaves, and a marked increase in flowering and fruiting, heavy pruning is required to promote the formation of new branches and a renewed canopy^[4]. Heavy pruning is widely applied in actual production and involves multiple technical aspects; if the techniques are not properly implemented or the measures are incomplete, it may easily fail to achieve the expected results or even lead to failure. Therefore, this paper focuses on elucidating the key technical measures for renovating low-yielding tea plantations by means of heavy pruning.

3.3 Stumping When, after heavy pruning, the plant vigor still cannot be restored, and dead branches and dry twigs appear inside the canopy, or even mosses and lichens grow abundantly on the framework branches, stumping should be adopted to thoroughly renovate the canopy. Stumping is generally carried out at a height of 10–15 cm above the ground^[4], which corresponds approximately to the height used for the first formative pruning.

4 Significance of renovating low-yielding tea plantations

Tea plants are perennial cash crops that, once established,

can be harvested for many years, with an effective economic lifespan of 40–50 years. As long as the cultivar is suitable, even if the canopy ages and results in low yield and poor quality, the plants can be restored to productivity and quality by re-establishing framework branches and productive branches through deep pruning, heavy pruning, or even stumping. Generally, deep pruning is required every 3–5 years, and after two or three rounds of deep pruning, heavy pruning is needed, which can maintain productivity for about 10 years. For plantations that can no longer respond to heavy pruning, stumping can be applied, which also sustains production for about 10 years. Compared with replanting with new cultivars, both heavy pruning and stumping offer the advantages of lower cost, shorter time, and earlier return to production. Replanting requires digging out the existing tea plants and establishing new ones, which typically takes 3–5 years to reach production and 5–8 years to achieve full yield. Therefore, renovation technologies for low-yielding tea plantations hold significant practical importance and economic value across the tea-growing regions.

5 Common misconceptions in renovating low-yielding tea plantations

During the renovation of low-yielding tea plantations in the Sichuan tea region, several common misconceptions are prone to occur: first, arbitrary pruning height, some practitioners assume that the lower the pruning, the better the renovation effect, rather than scientifically formulating a renovation plan based on the specific conditions of each plantation, which often leads to unsatisfactory outcomes; second, overemphasizing canopy pruning while neglecting supporting practices such as fertilization and pest control, under the mistaken belief that pruning alone is sufficient for renovation and that the plants will recover naturally, this approach usually yields poor results; third, rough and cracked cuts during heavy pruning or stumping, which cause the sprouting position to shift downward and delay bud break, if followed by prolonged drought, plants with severely cracked cuts are prone to dieback; and fourth, untimely renovation carried out between August and October or during winter, followed by premature plucking of premium tea shoots as soon as the spring tea flush emerges in the following year, this weakens the plant vigor after renovation and makes recovery difficult, thus defeating the purpose of the renovation.

6 Key techniques for renovating low-yielding tea plantations by heavy pruning

Heavy pruning involves multiple steps and, although it may appear straightforward, improper execution can easily lead to various problems and failure to achieve the desired renovation outcome. To this end, we summarize here the technical experience accumulated over many years of renovating low-yielding tea plantations by heavy pruning.

6.1 Time of heavy pruning Heavy pruning should preferably

be arranged from late April to late May, and no later than mid-June at the latest^[2]. This timing allows sufficient time after pruning for wound healing, bud sprouting, and shoot growth, enabling the newly regenerated branches to reach a length of over 80 cm and a diameter of approximately 0.20 cm. In the past, heavy pruning was mostly carried out in winter, with the main advantage being that it allowed more time for the tea plants to recover; however, its major drawback was the loss of spring tea income in the following year. Therefore, under the premise of balancing economic returns, especially given that most tea regions in Sichuan focus primarily on plucking premium tea in spring, the most appropriate timing for heavy pruning is immediately after the spring tea harvest. This approach ensures that all spring tea can be plucked to obtain the best income for the year, thereby maximizing economic returns.

6.2 Heavy pruning height The pruning height should be 50–55 cm above ground. To ensure accuracy, a measuring stick of 50–55 cm, made from readily available materials, can be used as a reference. Pruning is carried out using either a single-operator or double-operator pruning machine, and the blades must be checked for sharpness before operation. The cuts should be smooth, neat, and with as few cracks as possible^[4]. After pruning, the cut branches should be removed from the plantation and disposed of centrally; subsequently, any overly vigorous shoots on both sides of the tea rows should be completely cleared using a single-operator pruning machine or hand shears.

6.3 Soil fertilization after heavy pruning Low-yielding tea plantations are often deficient in soil nutrients and have insufficient fertility, making soil fertilization a critical step. Moreover, heavy pruning is equivalent to performing a major operation on the tea plants, and the healing of cuts, sprouting of new buds, and growth of new shoots all require substantial amounts of nutrients such as nitrogen, phosphorus, and potassium. It is recommended to adopt soil testing and formula fertilization, preferably by collecting soil samples for testing before the spring tea plucking, and then preparing the required fertilizers according to the soil nutrient analysis results. Immediately after pruning, furrows should be opened for fertilization at a depth of 20–25 cm and a width of 10–15 cm; the prepared fertilizer should be evenly spread into the furrows and then covered with soil. For those unable to adopt soil testing and formula fertilization, a compound fertilizer or a compound fertilizer specially formulated for tea plants can be applied at a rate of 400–500 kg/667 m², and where conditions permit, an additional 800–1 200 kg of organic fertilizer may be incorporated. After fertilization and soil covering, weeds should be removed and drainage ditches should be cleared.

6.4 Pest and disease control Pest and disease control after heavy pruning is of paramount importance. Following heavy pruning, the remaining leaf layer is minimal, and the baseline of pests and diseases surviving on the branches and leaves is substantially reduced compared with that before pruning, making this an optimal time for preventive treatment. It is recommended to apply lime

sulfur as a primary preventive measure. Lime sulfur is a traditional and effective pesticide, generally used during the non-productive season; since no plucking is required immediately after heavy pruning, its application is entirely feasible. Commercial crystalline lime sulfur can be purchased and diluted 300–500 times with water according to the instructions for spraying. During spraying, the framework branches, the stump base, the upper and lower surfaces of the leaves, as well as the soil surface and the surrounding areas of the tea plantation, should all be sprayed thoroughly and evenly to maximize the elimination of pathogens, pests, and mites, thereby achieving a better preventive effect. For plantations severely affected by pests and diseases, a second spraying of lime sulfur may be applied at an interval of 10–15 d to reduce the pest and disease baseline as much as possible. In the winter management of the same year, lime sulfur should continue to be used for the winter sealing treatment of the plantation^[5].

6.5 Canopy protection After new tea buds sprout and continuously develop into new shoots, the most important task is to protect these newly regenerated shoots. First, under no circumstances should the newly sprouted buds and leaves be plucked for any reason; otherwise, all previous efforts will be wasted and the renovation outcome will be severely compromised. Second, timely weeding is essential, especially in summer and autumn when weeds grow vigorously; a lightweight mower can be used for this operation. Third, pest and disease control should be carried out in a timely manner during the peak occurrence periods in summer and autumn, based on the actual situation; priority should be given to green control measures, and when necessary, low-toxicity, broad-spectrum, and highly effective pesticides may be applied.

6.6 Tipping and leveling By mid-to-late October, the current-season shoots can grow to about 80 cm in length, and some may even reach 100–120 cm. At this point, tipping and leveling should be carried out, *i. e.*, removing the tender buds and leaves at the shoot tips, so as to promote shoot hardening and nutrient accumulation.

6.7 Spring tea plucking in the following year Given that the retained branches are relatively long, when plucking the spring tea in the following year, pickers should be organized to harvest all sprouted new buds as fully as possible. At this time, the spring tea yield can increase by about 50% or more compared with that before pruning, and the quality of the fresh leaves is also substantially improved, thereby achieving the desirable outcome of "renovation in the current year and effectiveness in the spring tea of the following year."

6.8 Pruning after spring tea plucking in the following year After the spring tea plucking is completed in the following year, a second pruning should be carried out, raising the cutting height by 15 cm above the previous cut, *i. e.*, at 65–70 cm above ground. The cuts should be smooth, neat, and with as few cracks as possible, so as to promote the sprouting of more new shoots and the formation of productive branches, thereby establishing a sound canopy foundation for restoring high yield.

