

A Light and Simplified Branch Bending Method for Young Pear Trees

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Abstract Aiming at high cost and low efficiency of conventional branch bending method in the modern intensive planting and labor-saving cultivation mode of young pear trees, this paper provides a new branch bending method with wide source of raw materials, cheap price and simple operation, which is also suitable for the management of low-age branches in the process of high grafting and upgrading of traditional big trees.

Key words Pear tree; Light and simplified; Branch bending; Method

1 Introduction

Branch bending is an important means of shaping young pear trees, and it is also an important method of regulating tree potential and branch potential. The pear industry in China develops towards the direction of dense planting and labor-saving cultivation^[1–2]. At present, there is almost no suitable application of dwarfing rootstock in the production of pear trees in China. During the shaping process of young trees, the cultivation of strong central stem and the promotion of a large number of branches on the central stem can achieve the purpose of dispersing tree potential by increasing the number of growing points on the central stem, which has become the key technology for controlling tree potential in the early stage^[3]. With the continuous growth of the branches promoted on the central stem, the method of inhibiting vegetative growth and promoting reproductive growth has been adopted in production, to further control tree potential. The main approach is to form a certain angle of branches by promptly bending branches, inhibit the apical growth of branches, and promote the formation of flower buds, so as to achieve the purpose of early flowering, early fruiting, and controlling the crown by slowing the potential with flowers and pressuring the potential with fruits.

In the early growth stage of young trees, toothpick support is generally used to open the base corner. As the branches grow further, it is necessary to prop up or bend the branches. Compared with the traditional cultivation mode, the intensive planting and labor-saving cultivation mode has more branches on central stem, while conventional branch bending consumes much time, labor and materials, with low speed. When the orchard occupies a large area, the branches can not be quickly and timely bend to a certain angle, which is not conducive to the formation of high-quality flower buds.

Hao Baofeng *et al.*^[4] disclosed a method of opening waist angle in the shaping process of young pear trees. The main method is to use different support rods and appropriate methods to prop up branches at different growth periods of pear branches, so as to quickly form a certain angle of branches and promote flower bud differentiation. However, as the branches continue to grow, the branches at the crown base generally grow longer. Thus, this technology can not meet the production requirements, and this part of branches needs to be treated by bending.

Currently, the cultivation mode has undergone profound changes. The traditional method of bending branches to the central stem or trunk of the tree is difficult to meet the technical requirements of adjusting angle and orientation, with inconvenient operation. It is inconvenient for the mechanization operation of orchard by using conventional thick ground peg and branch bending method, or tying heavy object, or bracing wire along the row, *etc.*, and the location is not flexible. Besides, it will cause great damage to the ground cloth of pear orchard which is covered for grass prevention and soil moisture preservation. Rapid branch bending tools such as branch puller require the branch angle to be generally 90° or above, and the resilience of the branch can be used to improve the stability of the upper end of the branch puller hooked on the branch, which can not meet the technical requirements of pear tree with a small branch bending angle. For such branches, the method of leaving ground peg in winter shearing and re-branching is often used in the industry, which not only wastes the nutrition of the tree and causes wounds that are susceptible to diseases, but also affects the early yield.

Therefore, after years of practice and summary, a branch bending method with wide source of raw materials, low price and simple operation^[5] is proposed to meet the needs of young tree shaping in the current intensive planting and labor-saving cultivation mode of pear trees, and it is also suitable for the management of low-age branches in the process of high grafting and upgrading of traditional big trees.

2 Technical points

2.1 Softening by manually holding branches A small num-

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ber of branches at the crown base that can not open waist angle by propping up the branches should be treated by bending. Since pear tree branches are brittle, and generally can not be bent directly, manually holding branches (holding the branch with hand, gradually moving from base to tip, and breaking the xylem slightly) can be performed first. Compared with mature trees, the branches of pear trees in the sapling stage have a longer growth period and stop growing later. When the length of the branches at the crown base is 50 – 60 cm, manually holding branches can be performed to soften the branches, which is conducive to branch bending and the formation of appropriate angles. From the end of June to the beginning of July, if the length of base branches is less than 50 – 60 cm, manually holding branches should be generally conducted to prevent excessive growth in summer.

2.2 Finding a point of balance The branches are gently pressed or rotated to an appropriate position to meet the needs of uniform spatial distribution of branches. A point of balance on the branch can be found by pressing the branch with a finger, so that pressing this point of the branch is conducive to the formation of proper orientation and angle. It is difficult to control the crown of base branches, and the bending angle of branches can be appropriately large to 80° – 90° . The end of burlap thread or cloth strip is tied here with an active knot to prevent the injury of branches in the late stage of growth, and the balance point is the branch bending position of the rope on the branch.

2.3 Setting ground peg The other end of burlap thread or cloth strip is gently pulled to make the branch in proper orientation and angle and make the burlap thread or cloth strip reach the ground in the direction of bending branches. The point on the ground is the position where the ground peg is settled. The ground peg should be installed in the tree disk to avoid affecting other operations. The ground peg is a bamboo skewer with a length of 35 – 40 cm and a diameter of 4 – 5 mm (available on the market, mostly used for skewers such as sugarcoated haws on a stick), without cutting. The sharp end can be inserted into the soil by hand, and the reverse bending direction is about 45° with the vertical direction, while the ground part is retained only 1 – 3 cm.

2.4 Fixing and wrapping The other end of burlap thread or cloth strip is fixed to the ground part of ground peg in a dead-knot manner, which can wrap the ground peg when fixed.

3 Technical advantages

3.1 Wide source of raw materials and realization of mechanized production Compared with the traditional ground peg, the raw materials have the advantages of low price, lightweight and convenient, simple operation, fast and efficient, and can complete the setting of ground peg by hand without other tools (Figs. 1 – 2).

3.2 More flexible position of ground peg It can meet the purpose of adjusting angle and orientation, and has little influence on mechanical and manual operation. According to needs, a single bamboo skewer can pull 1 – 2 branches, causing minimally invasive damage to ground cloth (Fig. 2). Moreover, it can directly

avoid the drip irrigation pipe under the ground cloth, and can be used in the pear orchard laid with ground cloth for grass prevention and soil moisture conservation.



Fig. 1 Traditional ground peg (left) and bamboo skewer (right)



Fig. 2 Bending branches with bamboo skewer

3.3 Effectively solving the stability of bending branches by bamboo skewer The ground part of the bamboo skewer is only retained 1 – 3 cm, which is wrapped when fixed, avoiding the problem of easy breaking caused by sun exposure. Continuous years of practice has shown that the technical points can prevent the harm caused by large wind and rain and flood irrigation, and ground peg can meet the needs of the industry despite of small size.

3.4 Convenient post-processing The branch angle can be fixed after the use of a growth cycle. After rapid and efficient branch bending treatment, the flower bud can be formed in the second year to achieve the purpose of pressing crown with fruits, without any operation of branch bending. The ground peg used for bending branches does not need to be collected manually and can be used directly as fertilizer. The burlap thread will just break without untying the rope.

3.5 Suitable for multiple tree species and scenarios This

method is also suitable for the shaping of young trees such as apple and cherry, and the management of low-age branches in the process of high grafting and upgrading of traditional big trees.

4 Cautions

(i) This method is suitable for bending branches of the current and 1–2 year old branches, especially for bending base branches of the crown at the shaping stage of young trees. If the middle and upper branches of the crown can be braced, bending branches should not be used as far as possible.

(ii) For shoots of 1–2 years old, the bending operation should be conducted 20 d after flowering and terminated before the first pause of branch growth. Bending branches too early is easy to grow back branches, while bending branches too late can not form flower buds in that year.

(iii) The ground part of bamboo skewer should not be too long, and the over-long part should be cut, retaining only 1–3 cm. Bamboo skewer should not be replaced by iron wire or iron skewer, and the joint of burlap thread or cloth strip connected with bamboo skewer should be as close to the ground as possible to prevent the skewer part from being exposed to the sun, resulting in a

decline in toughness and fragileness.

(iv) The ground peg should be inserted within the row to the greatest extent, so as not to affect the mechanical and manual work as much as possible.

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