Pruning Techniques for *Prunus mume*

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Abstract *Prunus mume* has high ornamental value, and its maintenance and management should be more meticulous, with pruning being an important task. Pruning can make *P. mume* more robust, reduce the occurrence of diseases and pests, maintain a good shape, and promote more flowering, further improving its ornamental value. The difficulty of pruning lies in flexibly adopting suitable pruning methods according to the time of the tree, which requires understanding the impact of pruning operations on the growth and flowering of *P. mume*, as well as some techniques in pruning operations. This paper introduces the botanical characteristics of *P. mume*, common pruning methods and achievable effects of *P. mume*, and suitable time for using various methods, and analyzes the possible consequences and reasons of some incorrect operations. Moreover, corresponding correct practices are provided, which can provide reference for standardized pruning of *P. mume*, thereby reducing or avoiding losses caused by improper operation.

Keywords *Prunus mume*, Pruning, Viewing, Technology
DOI 10.16785/j.issn 1943-989x.2024.3.014

Prunus mume, belonging to *Prunus* of Rosaceae, is divided into eleven variety groups, among which the Longyou variety group only has one variety, *Prunus mume* var. *tortuosa* T. Y. Chen et H. H. Lu. Its branch shape is naturally twisted (Fig.1), and both the flowers and branches can be appreciated, making it a precious item in the plum blossom industry. It is named after its branches that naturally twist like a wandering dragon, without stem thorns. Flowers are butterfly shaped, with 4 layers and 16-25 petals, milky white, flowering from mid January to late February.

1 Pruning schedule

In order to ensure the healthy growth of *P. mume* and maintain its good ornamental value, it is necessary to attach importance to its pruning work. The most important pruning time is after flowering. The large-scale pruning of *P. mume* is usually arranged in spring when the remaining flowers are about to run out and the group of flowers has lost their ornamental value. At this point, the temperature rises and leaf buds will soon sprout, and the *P. mume* tree is about to enter a rapid growth period of the year. Pruning at this time can minimize nutrient depletion in the tree and promote its better growth without affecting the viewing during the *P. mume* blossom period. When leaf buds sprout, pruning of bud picking should be done while the buds are still small and have not consumed a significant amount of nutrients. After the branches grow out, the shoot pinching work should also be carried out immediately when the appropriate length of the branches can be retained. Operations such as shortening pruning and reduction pruning should be carried out in a timely manner when conditions permit, in order to preserve nutrients for the tree as much as possible. Operations such as picking and bending branches should be carried out when the flexibility of the branches is at its best to prevent them from being broken. If internal injuries occur to the xylem, it can also fully recover during the growth period of the year. Autumn pruning can help plants enter a healthier state before dormancy in winter. *P. mume* requires regular and appropriate pruning to control its condition, and timely handles problems such as diseased and insect branches, which helps it grow, bloom, and maintain its beautiful form.

2 Preparation work for pruning

Sharp branch clippers or pruners, saws, gloves, and other tools are prepared. Before pruning, the tools are checked, and any tools that are damaged, unstable, or have incomplete functions should be replaced in a timely manner[1]. Scissors and other tools should be clean and disinfected beforehand to ensure sharp edges.

3 Common methods and purposes of pruning

The main purpose of pruning is to eliminate the apical advantage, adjust the density and orientation of buds, and growth of various parts, resulting in a well-shaped *P. mume* tree that is well-ventilated and well-illuminated. This promotes healthy growth, encourages lateral branch development, and maintains an optimal flowering quantity. The overall order of pruning is from the outside in, starting with thinning and then cutting short.

3.1 Sparse pruning

Sparse pruning refers to cutting off all unnecessary branches or branch groups from the base[2]. Dead and diseased branches are thoroughly pruned to prevent infection or pest infestation of living parts. The sprouting branches at *P. mume* base should also be thoroughly pruned to avoid consuming a large amount of nutrients from the main trunk and causing poor growth of the main trunk. However, if the central part of the main trunk is damaged, it leads to severe decline in growth. In such case, it is also advisable to retain a few healthy and appropriately positioned basal tillers to prevent the plant from dying. These tillers can later be crossed over the damaged area and approach grafted onto the healthy portion above the main trunk. This approach facilitates nutrient transport across the damaged zone, creates bypass channels, or potentially replaces the damaged section of the main trunk altogether. For overlapping branches, parallel branches, intersecting branches, clustered branches, and parts with excessively dense branches, appropriate selection should be made based on their position and growth trend, so that subsequent new branches do not squeeze or block each other. For elongated branches, upright branches, old and weak branches, and inner branches, they should be pruned in principle. But if the structure of the tree crown at that location is too loose or incomplete, appropriate measures such as shortening and bending should also be taken to retain the better and stronger branches to fill in the gaps, making the plant

Received: May 12, 2024 Accepted: June 3, 2024

shape balanced and beautiful. This way, the root system of the plant will also grow evenly and be healthier, and the tree body will not be prone to lodging. The branches of *P. mume* often naturally bend and twist, making it difficult to form overlapping and parallel branches, but there can also be similar situations. If overlapping or parallel branches are very close together, there must be some trade-offs, and only one of them can be retained. If they are far apart, they can be pruned to have a significant difference in length, and the cutting buds of the two branches should be oriented differently, so that the new branches no longer overlap or parallel.

After the sparse pruning is completed, the view of the tree crown becomes more transparent, making it easier to observe and study how to proceed with the subsequent pruning of the remaining branches.

3.2 Shortening pruning

Shortening pruning refers to cutting off a portion of an annual branch to promote the growth and morphological adjustment of new branches, and the degree of pruning should be selected based on specific circumstances. For strong branches, they should usually be cut lightly, and the length of the cut off part should not exceed 1/5 of the total length of the branch. Due to the effect of apical advantage, the buds at the lower part of strong branches are difficult to germinate. Light pruning can weaken the apical advantage, stimulate the sprouting of buds at the lower part, disperse branch nutrients, promote short branches, form more flower buds, and make the plant shape more plump. For weaker branches, it is possible to trim the middle and short sections of the total length of the branches, ranging from 1/5 to 1/2, to promote their rejuvenation or extend the main branch. For weaker branches or weaker growing *P. mume*, heavy shortening pruning is adopted, cutting off branches that exceed 1/2 to 3/4 of the length of the branches. This has the effect of stimulating the germination of buds in the lower part of the branches, which is conducive to the regeneration and rejuvenation of weak trees or branches. But if the tree or branch has become extremely weak, it should be severely pruned, and most of the branches should be cut off, so that the hidden buds at the base can sprout new branches to replace the parts with poor growth from the previous year.

By shortening pruning, more new branches can be induced, making the branching points closer to the main trunk, and increasing the number of branches. The tree shape is more compact, and the tree body appears more aged.

3.3 Bud picking

P. mume trees often have a large number of buds sprouting at the same time. Due to poor or too dense growth sites, some of them can be wiped out before they have grown branches or flowers. This can reduce the waste of nutrients in the tree body, allowing the retained buds to be allocated more nutrients and better develop into branches, leaves, and flowers.

3.4 Thinning pruning

If the bud picking is missed, and the leaf buds have already sprouted into tender shoots (tender branches), remedial measures such as thinning pruning can be taken, which can also reduce the pruning difficulty and nutrient loss after the branches grow.

3.5 Shoot pinching

During the growing season of *P. mume*, the growth points of new branches are removed, that is, all or part of the young branches between the tip of the branch and the fully grown leaf parts are removed, which saves the nutrients originally provided for the growth of young branches and weakens the top advantage. This is beneficial for the middle and lower parts of the branch to grow stronger, lignify earlier, and the buds in the middle and lower parts to develop more fully, forming more flower buds. And it may also promote secondary branching, accelerating plant formation. When the young seedlings of *P. mume* grow to a height of about 20 cm, they should be picked and topped. When the new branch grows to about 15 cm, shoot pinching can be conducted.

3.6 Reduction pruning

If it is necessary to rejuvenate old branches or to control the appropriate volume of the tree crown, reduction pruning should be carried out. For example, when a large area of the tree crown is damaged by natural disasters, reduction pruning must be conducted to prevent infection and maintain a good crown shape. Inadequate maintenance causes the tree to weaken, and it can be restored through appropriate pruning and later strengthening and maintenance. After reduction pruning, the inorganic nutrients absorbed by the root system can be concentrated and supplied to a smaller range, providing better nourishment to the buds near the pruning site, and thus growing strong branches and leaves. *P. mume* cannot be excessively pruned. Excessive pruning during the dormancy period will cut off many flower branches, and a large number of sprouts and elongated branches will form during the growth period, seriously affecting the morphology and next flowering of plum trees. During the growth period, excessive reduction pruning is not advised, otherwise it will not only fail to activate the growth potential of *P. mume*, but also cause the plant to lose too many leaves and not grow enough functional leaves for a long time, which will further deteriorate the tree's vigor. After appropriate reduction pruning, the stability and resistance to external forces of *P. mume* trees are enhanced, improving their ability to prevent damage caused by weather conditions such as wind and rain.

3.7 Notching

Notching is cutting off the cortex of the branches of *P. mume*, with the wound reaching deep into the xylem. Lateral notching can block the downward transportation of organic nutrients and auxin on the injured side to some extent. The concentration of auxin below the wound decreases, relieve the growth inhibition and leaf buds sprout into branches. At the same time, the sprouting of leaf buds above the wound is inhibited, but it is more abundant due to the interception of organic nutrients, promoting the flowering of the upper branches. The wider and deeper the wound is carved, the stronger the blocking effect, and the deeper the impact on lateral branch growth. Vertical carving is beneficial for the trunk to grow thicker and form an old state. The notching should not be too deep, otherwise it will affect the tree's strength, and plum trees are prone to breaking or splitting from the cut.

3.8 Special treatment

In the production of *P. mume* bonsai, using the characteristic that the xylon of the plum tree is not perishable, the "excess" branches that can be cut off are often made into sacred stems or divine branches. Even through tearing, carving and other techniques, the main trunk is modified to increase the sense of aging of the tree body, satisfying the aesthetic taste of the plum tree's "noble old, not precious tender" and "old trees with new flowers"[3].

3.9 Other methods

In the pruning work of *P. mume*, the following methods are also commonly used: ① shoot twisting, twisting the semi lignified branches down 180°; ② pinching branch, pinching the xylem of the branch from the base to the end to cause minor damage; ③ broken branches, using a sharp blade to cut horizontally and diagonally downwards at a suitable position on the branch into 1/2−1/3 of the branch diameter, then bending the branch towards the opposite side of the incision, so that the cut xylem on the upper surface of the incision is lifted and pressed against the lower xylem, and waterproof treatment is applied to the wound (Fig.2). For

semi lignified branches, they can also be directly folded, breaking one side of the branch while keeping the other side intact.

Twisted twig——twisting and rubbing the new shoots, but do not separate them from the mother branch, in order to destroy the growth point of the new shoots, control their growth height, reduce nutrient consumption, and accumulate nutrients for flower bud differentiation. Unlike shoot pinching, this method is less likely to produce secondary branches. These methods all regulate the flow of sap, inhibit branch elongation, promote the occurrence of multiple lateral branches and flowering by causing certain degree of damage to the branches of *P. mume*, or by simultaneously changing the shape and extension direction of the branches. It is also common to use the method of inducing without damaging the branches——changing the original shape of the branches and fixing extension direction. Through techniques such as bending, binding, and coiling the branches, they were bent downwards, lift upwards, and formed circles to regulate the distribution of nutrients and auxins and affect the growth of the branches and flower bud differentiation.

4 Common problems and analysis

After understanding the above basic methods, it does not mean mastering the pruning techniques of *P. mume*. In practical work, some problems often arise.

a. Young trees b. Old trees

Fig.1 *Prunus mume*

a. Annual branch b. Biennial branch

Fig.2 Broken branches

4.1 Tight and sometimes loose pruning work

The level of emphasis on pruning work is unstable, and sometimes pruning is arbitrary, inadequate, or mishandled. The pruning work of *P. mume* should start from the young trees and not slack off every year in the future. If not pruned carefully during pruning, it is easy to cause the tree shape to deteriorate, and it will take several years to gradually correct.

4.2 Failure to achieve pruning according to tree's situation

There is no fixed formula to follow for pruning *P. mume*, and corresponding pruning strategies must be adopted based on the characteristics of the specific pruning object. If pruned according to the "mnemonic", it often cannot achieve good results. When pruning, it should observe the characteristics of plum trees first, and plum trees of different ages and growth should be treated differently. The main purpose of pruning young trees is to form shape as soon as possible, ease tree vigor, and bloom as soon as possible; the main purpose of pruning formed trees is to maintain good tree shape, grow healthily, and bloom more[4]. The pruning method and degree should be determined based on the position, posture, and growth of the branches. If *P. mume* has just been transplanted from the seedbed, due to the large degree of damage to the root system, its ability to absorb water decreases, and the rate of water loss in the tree body must be slowed down. Therefore, heavy pruning should be given to remove most of the branches and leaves, retain only the main trunk and main branches[5], and maintain an appropriate root crown ratio. But if the container seedlings are planted with intact soil balls, the root system is basically not damaged, and only the plum tree needs to adapt to the new environment, so it does not need to be pruned severely.

4.3 Improper handling of pruning wound buds

The handling of pruning wound buds is a detail issue that is easily overlooked, but it is also a relatively important technical matter in reality. When pruning, pruning wound buds should be left according to the desired growth direction. The oblique cutting surface of the pruning wound should be opposite to the direction of the pruning wound buds, and the distance between the pruning wound and the base of the pruning wound buds should be maintained at about 5−10 mm. If the pruning wound is too far from the pruning wound bud, there will be too many useless and nutrient depleted branches left

above the pruning wound; if it is too close, the pruning wound buds are prone to losing water and being dried to death. In the selection of pruning wound buds, full consideration should be given to the growth of the branches to be pruned and the distribution of the branches within the tree crown. If you want to suppress the vigorous growth of the branches, weak buds can be kept as pruning wound buds; otherwise, full and strong buds can be kept as pruning wound buds[6].

4.4 Not paying attention to protecting the wound

Neglecting wound protection is a common problem, and even relying entirely on wound self-healing can lead to infection in larger wounds, gradually spreading the scope of infection. Not only does it fail to achieve optimal pruning, but it also requires subsequent treatment. Or because the wound is too large and loses water too quickly, nearby living tissues may dry up and form dead branches. Therefore, it should choose the appropriate scissors when pruning based on the thickness of the branches, determine the position, angle, and cut with force in one go to achieve a smooth and non cracking cross-section. This way, the wound is small and easy to heal. This requires regular maintenance of tools such as scissors to maintain their sharp edges and good performance. Pruning should not be carried out on rainy days. After pruning, it does not water immediately. Large wounds caused by pruning should be promptly coated with protective agents, sterilized, and treated with waterproofing.

4.5 Neglecting the aesthetic characteristics of *P. mume*

The texture of the trunk and branches of *P. mume* trees is dry and hard; the flowers are small and bloom before the leaves, suitable for creating an old but vibrant landscape, giving people the joy and excitement of withered trees blooming. Fan Chengda in Song Dynasty summarized the essentials of appreciating plum blossoms and also pointed out the direction for pruning, shaping, and landscaping of plum blossoms. Although Gong Zizhen in Qing Dynasty used "sick plum" as a metaphor for political affairs, it also expressed the aesthetic standards of plum blossoms. So plum blossoms are beautiful in terms of slanting, curved, sparse, and thin. *P. mume* is not only a type of plum, but also needs to be pruned in accordance with the above aesthetic principles. And its branches are naturally twisted, resembling the tree shape of a swimming dragon, and creating a linear beauty of swimming. At the same time, the dragon is a symbol of the Chinese nation, which further enhances its affinity. When pruning, twisted and peculiar parts should be preserved to the greatest extent possible, and reasonable utilization should be made in the shaping concept. Pruning is a process of shaping shape, which should comprehensively consider the biological and aesthetic characteristics of plum blossoms, as well as the twisted characteristics of *P. mume*, in order to maintain their beautiful form and promote healthy growth. Especially when pruning, it does not leave branches too dense, otherwise the branches will twist and crowded together, making the curly posture invisible.

5 Conclusions

In summary, pruning is an important task in the maintenance of *P. mume*, with many methods and different effects. It should be flexibly applied in different stages of *P. mume* growth, taking into account its growth status, aesthetic characteristics, and other factors. At the same time, it should strengthen water and fertilizer management, pest control and other maintenance work, to cultivate high-quality *P. mume*.

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herbaceous flowers by municipal departments should be enhanced, and relevant personnel can be organized to conduct irregular learning and training to understand the repair and maintenance knowledge of herbaceous flowers.

5.3 Mainly using flowers that are resistant to harmful gases

Urban roads belong to the gray area of a city, so the herbaceous flowers used in urban road greening should have strong ecological adaptability, and it is recommended to choose grade-A or grade-B flowers with strong resistance in urban road greening, such as *Dianthus chinensis*, *Oxalis corniculata* L., and *Calendula officinalis* with strong resistance to sulfur dioxide carnation, as well as *Begonia grandis* Dryand., and *Ipomoea nil* (L.) Roth with strong resistance to hydrogen fluoride. Meanwhile, some herbaceous flowers that can monitor atmospheric pollution can be chosen, such as *P. hybrida* that can monitor ozone, *Z. elegans* that can monitor chlorine, and *B. grandis* Dryand. that can monitor nitrogen oxides. Thus, the pollution problems in roads can be found and solved in time, and the ecological benefits of herbaceous flowers can be enhanced.

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