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# Impact of Autumn Pruning and N-K Ratio Regulation on Yield Performance of Loquat in the Following Year

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**Abstract** This study summarized the effects of autumn pruning and the regulation of the nitrogen-potassium (N-K) ratio on the yield and fruit quality of loquats. Pruning in autumn can promote the growth of new shoots, make the tree crown more reasonable, and also accumulate more nutrients for photosynthesis. All these lay a foundation for flower bud differentiation and fruit growth. The regulation of the ratio of nitrogen to potassium can help make nutrient distribution more reasonable, make trees more resilient, and also promote sugar transportation, thereby increasing yield and quality. The combined use of these two management methods can make the vegetative growth and fruiting growth of loquats more balanced, the size of the fruits more uniform, and also extend the high-yield period of the orchard. Based on some field cases, this study also proposed more appropriate pruning methods and more precise nitrogen and potassium management plans. This study aims to provide a reference for high-yield and high-quality production of loquat, making the planting management more scientific and effective.

**Keywords** Loquat; Autumn pruning; N-K ratio; Fruit quality; Cultivation management

## 1 Introduction

Loquat is an evergreen fruit tree. Its flower bud differentiation and fruit development cycle is very long, lasting from autumn and winter to the following spring and summer (Zhao, 2024). The management after harvest has a significant impact on the yield and fruit quality in the following year (Pareek et al., 2014; Zargar et al., 2018). Pruning is a commonly used post-harvest management method, which can affect flower bud differentiation and fruit cell division by regulating branch growth and leaf quantity, as well as change fruit size and total yield in the following year (Gupta et al., 2022; Su et al., 2024). Appropriate flower bud thinning and reasonable nutrient management can lead to better fruit quality and more stable yield (Nordi et al., 2025).

Pruning and regulation of the nitrogen-potassium ratio are two important measures in loquat cultivation. Pruning can promote the growth of new shoots and leaves and provide more photosynthetic products for fruit development (Su et al., 2024). The reasonable adjustment of the ratio of nitrogen to potassium is conducive to the rational distribution of nutrients, promotes cell division and fruit enlargement, thereby enhancing yield and quality. In other fruit trees and crops, nitrogen-potassium ratio management has been proven to significantly affect yield and nutrient use efficiency (Gu et al., 2017; Ali et al., 2019; Fallah et al., 2021), but there are not many systematic studies on loquat.

This study analyzed the combined effects of autumn pruning and the regulation of nitrogen-potassium ratio on the second-year yield and fruit quality of loquat, and explored the synergistic mechanism of the two. This study aims to provide theoretical references and management suggestions for the efficient and high-quality production of loquats.

## 2 Autumn Pruning Practices in Loquat

### 2.1 Typical timing and intensity levels for autumn pruning

Autumn pruning of loquats is usually carried out from the time of fruit harvest to the growth of new shoots, with the main purpose of promoting new shoots and adjusting the tree shape. Pruning is divided into three types: mild, moderate and severe. In recent years, some studies have proposed the “double retraction” pruning method, which

means conducting retraction pruning twice a year. This method can make the branches thicker and have more leaves, laying the foundation for large fruits to grow in the second year (Su et al., 2024). When pruning, cross branches, diseased and insect-infested branches, and weak branches should also be removed. Then, based on the number of branches, an appropriate amount should be retained to ensure good ventilation and light for the tree.

### 2.2 Effects on shoot maturation, flower bud differentiation, and carbohydrate accumulation

Pruning in autumn can make new shoots grow faster and mature well, and also promote flower bud differentiation. Research has found that vigorous new shoots are more conducive to cell division and flower bud formation, thereby affecting the size and yield of fruits (Su et al., 2024). After pruning, the diameter of the central branches will increase, the leaves will be thicker, the internodes will be shorter, the quality of the fruiting mother branches will be higher, and the weight and sugar content of the single fruit will also increase. In addition, pruning helps accumulate more carbohydrates, storing energy for the development of flower buds and fruits in the following year.

### 2.3 Impacts on disease management and canopy microclimate

Reasonable autumn pruning can also improve the canopy structure, enhance ventilation and light conditions, and reduce pests and diseases. By adjusting the main branch Angle and branch distribution, the light distribution in the tree canopy can be made more uniform, the photosynthetic efficiency can be improved, and the microclimate environment in the garden can be enhanced (Tang et al., 2019). This can not only improve the quality of the fruit, but also facilitate daily management and pest control.

## 3 Nitrogen-Potassium (N-K) Ratio Regulation Principles

### 3.1 Roles of nitrogen and potassium in vegetative and reproductive growth

Nitrogen (N) can promote the growth of loquat branches and leaves, enhance the photosynthesis of leaves, drive the growth of branches and leaves, and increase the biomass of the plant. Potassium (K) plays a significant role in regulating water metabolism, enhancing stress resistance, promoting carbohydrate transport and improving fruit quality (Huang et al., 2020; Ali et al., 2021). Proper combination of nitrogen and potassium can enable loquat to maintain a balance between vegetative growth and reproductive growth, and increase yield and fruit quality (Yang et al., 2023; Zhao et al., 2024). Zhang et al. (2025) recently proposed that excessive application of nitrogen or potassium could disrupt the nutritional balance, affect the diversity of arbuscular mycorrhizal fungi (AMF), and influence the rhizosphere microecology and nutrient absorption.

### 3.2 Seasonal dynamics of nutrient demand in loquat trees

In spring and summer, new shoots and leaves grow rapidly, and the demand for nitrogen in loquats will increase significantly. During the fruit expansion and ripening stages, loquat has a significantly increased demand for potassium, which is beneficial for fruit development and flavor enhancement (Yang et al., 2023). Soil moisture and climatic conditions can also affect the availability and absorption efficiency of nitrogen and potassium. Hu et al. (2023) and Zhao et al. (2024) both hold that fertilization should be flexibly adjusted in accordance with seasonal changes and environmental conditions.

### 3.3 Common fertilization strategies to achieve target N-K ratios

Precision fertilization is the core to controlling the N-K ratio well (Gomes et al., 2020; Xu et al., 2020). Common methods include: applying nitrogen and potassium fertilizers in stages and in appropriate amounts based on soil nutrient testing and the growth stage of loquats. Combined with the spatial distribution of available nitrogen and available potassium in the soil, focus on supplementing the deficient nutrients (Zhao et al., 2024). Meanwhile, excessive fertilization should be avoided and bio-fertilizers (such as bio-fertilizers containing AMF) should be used appropriately to improve nutrient utilization rate and soil ecological stability (Zhang et al., 2025). In actual management, it is recommended to dynamically adjust the nitrogen-potassium ratio in combination with soil testing, weather conditions and the growth cycle of loquats to achieve high-yield, high-quality and sustainable production (Hu et al., 2023).

## 4 Physiological Responses to Autumn Pruning

### 4.1 Redistribution of photosynthates and nutrient reserves

Pruning in autumn can make the new shoots of loquats grow faster, with more leaves, thicker branches, stronger photosynthetic capacity of the tree and more nutrient accumulation. After pruning, the tree will transport more photosynthetic products and nutrients to the newly grown branches and flower buds, laying a solid foundation for flowering and fruiting in the following year. Su et al. (2024) found that strong new shoot cells divide more rapidly, which can promote the development of flowers and fruits, making the fruits larger and increasing their yield.

### 4.2 Hormonal regulation and shoot-flowering balance

Pruning can alter the distribution and content of hormones in loquats, affecting the balance of branch growth and flower bud differentiation. It can inhibit some factors that hinder cell division, making cells more prone to proliferation and promoting the formation and development of flower buds (Su et al., 2024). Hormonal changes can also affect the ratio of flower buds to vegetative buds, making the flowering and fruiting in the following year more harmonious.

### 4.3 Influence on root activity and nutrient uptake efficiency

After autumn pruning, the growth center of the tree will shift downward, which is conducive to root regeneration and enhanced activity. More active root systems can absorb water and nutrients more efficiently, which is very important for the growth of new shoots and flower buds and can also indirectly increase the yield of the following year (Cai et al., 2002).

## 5 Physiological Responses to N-K Ratio Regulation

### 5.1 Effects on floral induction, fruit set, and early fruit development

Reasonable pruning methods, such as double-head pruning, can make new shoots grow faster, have more leaves and thicker branches. This will provide more nutrients and energy for flower bud differentiation and fruit development. Research has found that during the flower bud differentiation stage, the enhanced cell division ability significantly affects the size of flowers and fruits. Pruning can down-regulate cell division inhibitory genes (*EjFWL1*, *EjFWL2*), promote cell proliferation, and ultimately result in larger fruits and higher yields (Figure 1) (Su et al., 2024). In addition, appropriately thinning off some flower buds can also increase the fruit setting rate and make the fruit development more uniform. Maintaining a reasonable number of flower buds can result in a higher fruit setting rate and larger fruits (Nordi et al., 2025).

### 5.2 Interaction with water uptake and osmotic regulation in fruit cells

Adjusting the ratio of nitrogen to potassium can affect the distribution of mineral elements in leaves and soil, thereby indirectly altering the regulation of water absorption and osmosis in fruit cells. When the supply of potassium in leaves is sufficient, the osmotic regulation ability of cells will be better, which can promote fruit enlargement and water accumulation, which will directly affect the size and texture of the fruit (Huang et al., 2021).

### 5.3 Changes in fruit quality attributes such as size, sweetness, and firmness

Mineral nutrition, especially the balanced supply of nitrogen and potassium, has a significant impact on quality indicators such as single fruit weight, soluble solids (sweetness), and acidity. Studies show that the content of K and N in leaves is closely related to the weight and sweetness of the fruit. Reasonable adjustment of the N-K ratio can enhance the sweetness and flavor of fruits (Huang et al., 2021). Meanwhile, combined with reasonable flower thinning and pruning, it can also make the size and appearance of the fruit better and increase the commercial value (Nordi et al., 2025).

## 6 Integrated Effects of Pruning and N-K Regulation

### 6.1 Synergy in promoting balanced vegetative-reproductive growth

Autumn pruning can make new shoots grow faster, with more leaves and thicker branches, providing more nutrients for flower bud differentiation and fruit development. Su et al. (2024) found that pruning methods such as double backcutting can promote cell division, inhibit the expression of some division inhibitors, and lead to better

development of flowers and fruits. Reasonable adjustment of the ratio of nitrogen to potassium, especially scientific proportioning of these two elements in the base fertilizer, can make the branches thicker and have more leaves, which is beneficial to the growth of flowering and fruiting branches. The coordination of these two management measures can make vegetative growth and reproductive growth more balanced, avoiding a bias towards only one direction, which could lead to a decline in yield or quality.

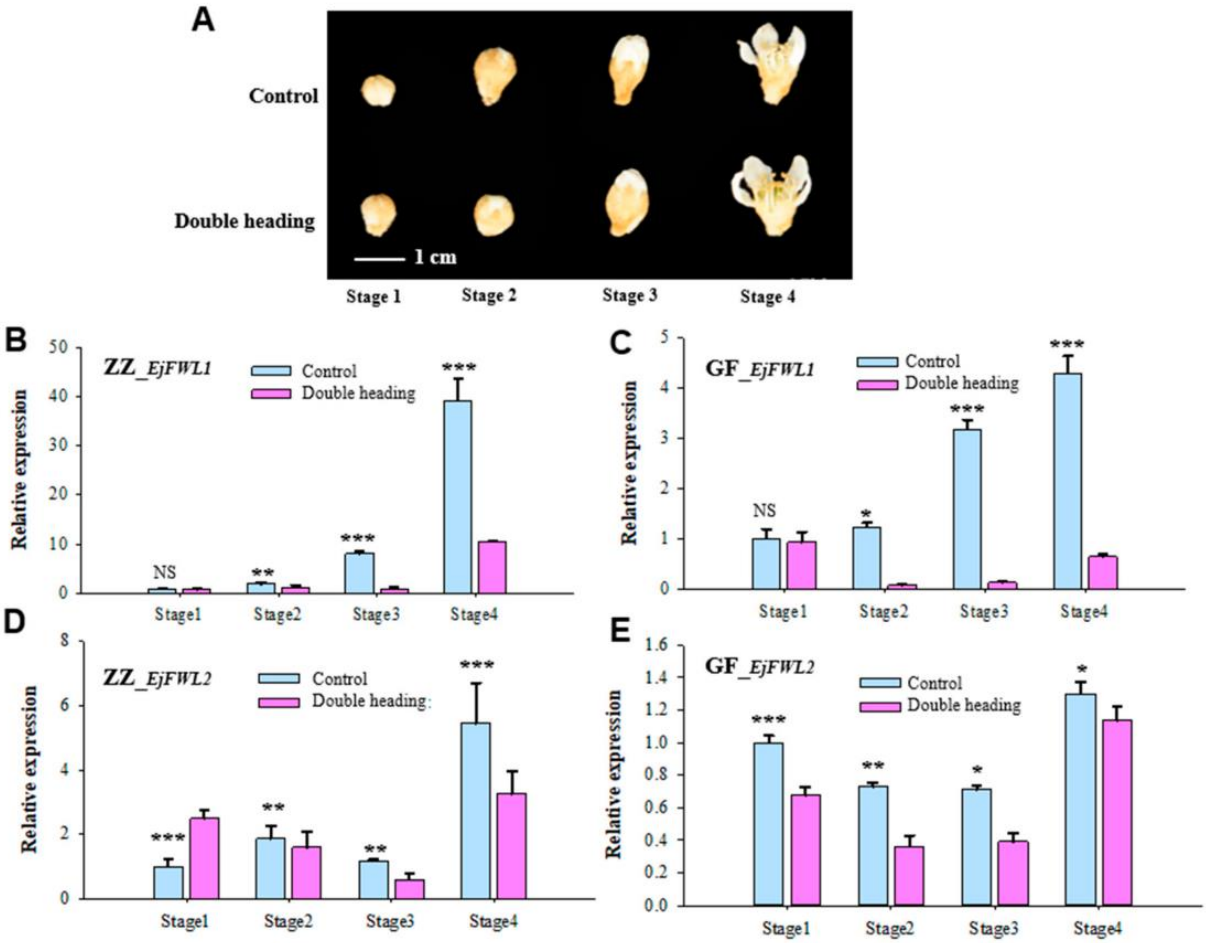


Figure 1 *EjFWL1* and *EjFWL2* gene expression patterns of loquat flowers under two pruning systems (Adopted from Su et al., 2024)
Image caption: (A) The vigorous shoots under the double-heading system promoted flower enlargement on GF during the flower development stages. The expression patterns of *EjFWL1* on ZZ (B) and GF (C) before the flowers bloomed under two pruning systems. Expression patterns of *EjFWL2* on ZZ (D) and GF (E) before the flowers bloomed under two pruning systems. NS indicates no significant difference between the control and the vigorous groups. *, ** and *** in each stage indicate $p < 0.05$, 0.01 and 0.001, respectively, conducted using one-way ANOVA in SigmaPlot software (Adopted from Su et al., 2024)

### 6.2 Contribution to stable yield and improved fruit uniformity

Pruning combined with N-K regulation can not only make individual fruits heavier and larger, but also make the distribution of flower branches and fruits more reasonable, the fruits more uniform and the appearance better (Su et al., 2024). For instance, under a reasonable basic fertilizer formula (containing nitrogen, potassium and organic fertilizer), the yield of each tree can increase by 14.5 kilograms, and the fruits are larger and evenly distributed.

### 6.3 Influence on tree health and long-term orchard productivity

Scientific pruning and N-K ratio can make trees more vigorous, improve stress resistance, allow the root system and above-ground parts to grow healthily together, prolong the tree age and maintain high orchard yield (Su et al., 2024). Pruning can promote the healthy growth of new shoots, and N-K regulation can enable nutrients to be absorbed and distributed more reasonably. The combination of the two makes the tree stronger and the yield more stable.

## 7 Case Study: Field Experiment in a Commercial Loquat Orchard

### 7.1 Orchard background, cultivar selection, and experimental treatments

The field trial of this case was conducted in a typical commercial loquat orchard, and the traditional high-yielding but small-fruit-bearing main varieties were selected. The experiment compared two methods, conventional pruning and double-cut pruning, and combined different nitrogen-potassium (N-K) fertilization ratios to evaluate the effects of autumn pruning and N-K ratio regulation on the yield and fruit quality in the second year (Su et al., 2024).

### 7.2 Comparative results on yield performance, fruit quality, and growth indices

The results showed that the branches of loquat trees pruned by double cutting were thicker, the leaves were more, the flower bud differentiation and cell division were more active, the fruits were larger and the yield was higher (Figure 2) (Su et al., 2024). In terms of quality, moderate flower thinning (retaining 4 flowers per inflorescence) can increase the single fruit weight and sweetness, while leaving more flower buds (such as 12) is beneficial to increase the total yield (Nordi et al., 2025). Although this experiment did not directly study the N-K ratio, studies on other crops have found that increasing the ratio of potassium fertilizer can improve nitrogen metabolism, promote leaf growth, and increase yield (Ali et al., 2019). It is speculated that a similar effect will also occur on loquats.

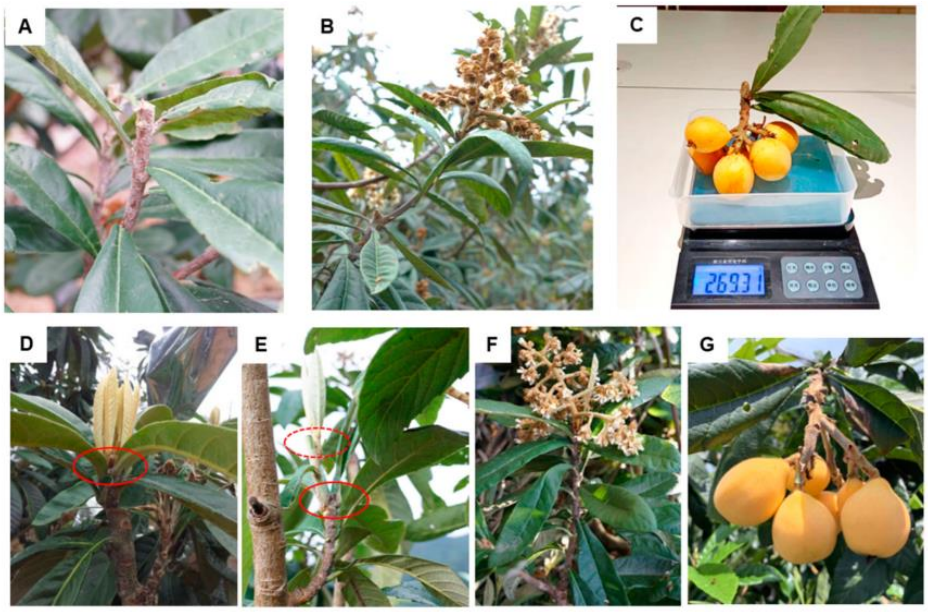


Figure 2 Effects of the common pruning and double-heading system (Adopted from Su et al., 2024)

Image caption: (A-C) Common pruning procedure with one back-cutting in loquat. (A) Fruit-bearing shoot that was back-cut after the fruit ripened. (B) Shoot apex that developed into flower clusters in autumn. (C) Fruit that ripened during the next spring. (D-G) Vigorous shoot developed a pruning system with double back-cutting. (D) Fruit-bearing shoot that was cut back after harvest. The solid cycle shows where the first heading was performed. (E) Summer shoots that were back-cut again in late summer or autumn when the apex developed into a small panicle. The solid and dash cycles show where the first and second heading were performed. (F) Shoot apex with a double-heading that developed into a larger panicle the next autumn. (G) Larger fruit in one cluster produced by a double-heading in the spring of the third year (Adopted from Su et al., 2024)

### 7.3 Practical recommendations derived from field trial outcomes

Based on these results, Su et al. (2024) suggested the use of double-cut pruning in loquat production to promote the robustness of branches and flower bud differentiation, and to increase fruit size and yield. During the flowering period, flowers can be moderately sparse, leaving 4 flowers per inflorescence to balance yield and quality (Nordi et al., 2025). In terms of fertilization, the proportion of potassium fertilizer can be appropriately increased to maintain the balance of nitrogen and potassium and optimize the growth and yield performance of plants (Ali et al., 2019). These measures are helpful for achieving the goal of high-yield and high-quality loquat production.

## 8 Concluding Remarks

Autumn pruning can promote the growth of new shoots and cell division, thus making loquat fruits larger and with higher yields. By using the double-cut pruning method, the branches will be thicker and there will be more leaves, all of which can provide more nutrients for fruit development. The peak of cell division mainly occurs before flower bud differentiation. Flower bud thinning is also very important. For instance, keeping four flower buds per inflorescence can make the fruit sweeter and of better quality. If 12 flower buds are retained in each inflorescence, it will be more conducive to the total yield. Although there is no specific study on the N-K ratio for loquats at present, other fruit and vegetable experiments have shown that increasing the potassium fertilizer ratio (such as N:K=1:2) can help improve yield and quality, indicating that it may also be effective for loquats.

In production, it is recommended to adopt double-cut pruning in autumn to promote the growth of new shoots and the differentiation of flower buds, laying a solid foundation for the size and yield of fruits in the following year. When thinning flower buds, if the goal is high quality, four flower buds can be retained per inflorescence. If the goal is high yield, more flower buds can be left. Fertilization can refer to the experience of other crops and appropriately increase the proportion of potassium fertilizer (for example, N:K=1:2) to enhance both yield and quality simultaneously. Pruning and fertilization plans should be flexibly adjusted according to the growth of the tree and the yield target to maintain a balance between growth and fruiting.

However, there is currently a lack of systematic trials on the effects of different N-K ratios on the yield and quality of loquats. The synergistic effect of autumn pruning and N-K ratio regulation is also not clear enough. The comprehensive effects of pruning and fertilization on the stress resistance, nutritional components of the fruit and the commercial appearance of loquats still need to be further studied. In the future, the focus should be placed on exploring a management model that combines pruning and the N-K ratio, and clarifying their mechanisms of action in the sustainable and efficient production of loquats.

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### Conflict of Interest Disclosure

The author affirms that this research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

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