

Fruit Safety Production Technology

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Abstract The edible safety factor of fruit can be greatly improved by the following measures: avoiding industrial and mining pollution areas in orchard construction; reasonable shaping and trimming to maintain good light and ventilation conditions; strengthening soil, fertilizer and water management, and increasing the application of organic fertilizer to enhance the resistance of trees to bacterial infection; growing grass and mulching to avoid the exposure of soil surface and prevent the spread of harmful soil-derived bacteria; trapping pests and delaying their damage in the tree, to facilitate centralized killing; preventing and treating diseases and pests through biological and physical non-pharmaceutical means such as underplanting, solar insecticidal lamps, sex attractant, sweet and sour liquid, ozonizer, etc.; strengthening the use of mineral-based, plant-derived and biological agents, and reducing the use of chemical pesticides to avoid pesticide residues.

Key words Fruit; Safe production; Pest control

1 Introduction

The awareness of fruit safety should run through the whole life cycle of fruit trees, especially the production and cultivation process. Comprehensive technical means can be adopted to keep the soil and plant healthy, reduce the application of pesticides and fertilizers, reduce or avoid chemical pollution, and solve the problem from all aspects of production management. We have been engaged in fruit tree production for many years, and want to share the experience with readers.

2 Orchard construction

Site selection should avoid industrial and mining pollution areas, stay away from traffic arteries, and do not pollute river water, so as to ensure the clean and safe production environment.

The planting pattern is determined according to site conditions. Ridge planting with convenient irrigation and drainage can be adopted in plain land, which is conducive to reducing the air humidity in the orchard, reducing the risk of diseases, minimizing the use of drugs, and promoting the growth of fruit trees, high quality and early yield. Rainproof and pest prevention cultivation is usually adopted, and rain shelter and insect proof net are widely used in grape and other facilities cultivation, which can reduce the diseases caused by rain, isolate pests and reduce medication, receiving a good effect. However, it has high practice cost in apple, pear and peach cultivation.

3 Soil, fertilizer and water management

3.1 Grass growing or mulching Inter-row grass growing and mulching under tree is implemented in the orchard. Grass growing and mulching have the effects of reducing bare ground, increasing soil organic matter content, regulating soil moisture, absorbing excessive water in soil after rain, reducing bacterial infection and reducing drug use.

Self-sown grass is the best choice for inter-row grass growing.

Naturally growing weeds have strong vitality and high yield, but malignant weeds and climbing weeds should be eradicated. For the plots where self-sown grasses can not form a complete grass cover, grass should be artificially replanted. The best grasses for replanting are *Salvia roborowskii*, *Medicago sativa* and *Trifolium pratense*. *M. sativa* is salt-tolerant and has strong vitality, but it is difficult to be mowed. And it is easy to cause soil compaction due to developed roots, and must be ploughed and replanted after 3–4 years. *S. roborowskii* grows in autumn and winter until summer, and crawls down to cover the ground after its life ends. Other weeds can no longer grow in the covered area, and it will germinate in autumn and winter but is free from mowing. It is a good grass seed for artificial grass planting, but with weak vitality, so it is necessary to thoroughly irrigate and carefully prepare the land before sowing, and irrigate water promptly to maintain moisture content after germination. Natural weeds in the plain area have strong vitality, and usually no additional replanting is required. Inter-row grass growing must be mowed promptly to reduce the competition for soil water. The inline weeds should be mowed in time to avoid poor ventilation under the tree, high air humidity and pathogen transmission, which will easily induce snails and slugs to harm the leaves and fruits.

It is appropriate to select local crop straw, rice husk, edible mushroom waste, weeds, etc. as the mulch under the tree, with low cost and easy collection. It is better to mulch after the application of base fertilizer in autumn, and insulate and moisturize in winter, but it also depends on easy collection time of mulch and easy operation season in the orchard. The mulching thickness should not exceed 20 cm, while mulching is continued if it becomes decay and thinning. The grass should fall to the tree in the row as far as possible when mowing grass between rows.

3.2 Application of large amounts of organic fertilizer A fertilization system based on organic fertilizer, farmyard manure and biological fertilizer should be established, and the content of soil organic matter is increased, to fundamentally improve the soil, and ensure the full supply of various nutrients required for the growth and development of fruit trees. As a result, fruit can

grow robustly and have strong disease resistance, which will further facilitate high yield, improve fruit quality, and obtain high earnings. The application amount of each fertilizer type should be determined comprehensively according to soil fertility and tree phase index on the basis of soil detection and leaf analysis. If sufficient and large organic fertilizer is applied, inorganic fertilizer can be applied in small amount or even be completely abandoned, which will lead to better fruit quality and avoid chemical pollution of the soil. However, the production cost will also rise accordingly. Therefore, the amount of fertilizer should also be determined by product market positioning, cost accounting and comprehensive benefit. For an apple orchard (soil pH 8.5), 1 000 kg of Nongda biological organic fertilizer, 25 kg of humic acid compound fertilizer and 50 kg of soil conditioner (alkali adjustment) have been applied annually in the last 6 years. The annual output per 666.7 m² is about 4 000 kg. The fruits have smooth surface, good color, and the soluble solid content of the fruit is more than 18%.

3.3 Reasonable water regulation Except that the freezing water and budding water can be flooded, water should be irrigated frequently in small amount in the growing season according to soil moisture and tree phase indicators, and it is better to perform underground infiltration irrigation, surface drip irrigation and micro-irrigation, so that soil water, fertilizer, gas, heat and other factors are coordinated. Drainage is conducted promptly in rainy season, to reduce the air humidity in the orchard, reduce the risk of pathogen infection and minimize the use of drugs.

4 Tree management

4.1 Reasonable pruning The orchards with high planting density tend to be closed, with high air humidity, heavy occurrence of diseases and pests, and heavy use of drugs, which greatly threaten the safe production of fruits. With the growth of tree age and the enlargement of tree body, the number of backbone branches per plant should be reduced year by year. Trunk tree increases the height of trunk year by year, and the main branches renew in time. The interplant junctions are retracted to small branches or base small branches are retained to remove the large ones. As long as the small branches within 1.5 m of extension on the trunk do not overlap, they are retained as far as possible, forming a tree structure with large bottom and small top, and the total number of branches per 666.7 m² is controlled within 40 000. A dense planting garden should be timely thinned, to keep the garden ventilated and transparent, reduce the occurrence of diseases and pests, and reduce the number of medications.

Summer pruning is strengthened to promptly cut off water sprouts and tightly squeezed branches, in order to maintain good light and ventilation conditions in the crown. Operators should avoid girdling to reduce diseases, pests and nutrient deficiency symptom induced by poor wound healing.

4.2 Fruit bagging Fruit bagging in time can effectively isolate pesticides, prevent pollution and avoid pesticide residues, and the fruits will have smooth surface and bright color. But the produc-

tion cost will increase in case of bagging. The preventive measures such as mulching grass and raising trunk can reduce the harm of diseases and pests, but their fruits have inferior color than bagging fruits.

4.3 Pest control

4.3.1 Underplanting. Raising chickens and ducks under the tree to prey on pests instead of applying pesticides can yield twice the result with half the effort. However, it is necessary to carefully choose chicken breeds that do not go up trees. Appropriately 2–3 chickens or ducks can be raised per 666.7 m², while a larger density of chickens or ducks will step on the soil excessively, damage the soil structure, and affect the soil permeability. In order to ensure the predation efficiency of chickens and ducks, they are not fed at ordinary times and are only given foodstuff in winter.

4.3.2 Using sex attractant. During the mating period of insects, sex hormones or similar substances are made into sexual lure core and sexual lure rod to disturb the mating of pests and reduce the density of insects, which has received good effect in the prevention and control of fruit moths. At present, there are more and more types of sex attractants, and the female pheromone attractants for oriental fruit moth and peach fruit moth are mostly applied in fruit trees. There are also many types of commercial traps, such as paste type, basin type, dry universal type, *etc.* In the production, the author placed universal and solar insecticidal lamps at the same point, and there had been no fruit harmed by fruit moths for years.

4.3.3 Combining solar insecticidal lamp, sweet and sour liquid, and armyworm board. The solar frequency vibration insecticidal lamp uses ultraviolet radiation to produce phototaxis excitatory effect on pests, inducing pests to jump to the light source, and the light source is equipped with high voltage killing net to kill pests. It has a wide insecticidal range and can kill all flying pests. Because of special wavelength, it can also protect beneficial insects, which is conducive to ecology, energy saving and environmental protection, and is safe and convenient. A solar frequency vibration insecticidal lamp can radiate an area of 2 hm², but with large one-time investment. Large-scale orchards or contiguous orchards can collectively purchase, and it may be more cost-effective with reasonable layout. The production practices show that there are large golden turtles with weak phototaxis, which can be killed combined with sweet and sour liquid. The sweet and sour liquid prepared by liquor (above 50 degrees), brown sugar, vinegar and water at a ratio of 1 : 1 : 4 : 16 can be placed in the insect-catching tank. Some pests falling into the insect-catching tank are still alive, which can be killed with boiling water. Sticky trap is often combined with solar insecticidal lamp, sweet and sour liquid, and sexual lure core, and is placed centrally for better use effect.

4.3.4 Binding straw bundle. After harvesting in autumn, straw bundles are tied to the trunk to attract Lepidoptera pests and mites that seek places to overwinter, and carefully removed and burned before germination in spring.

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4.3.5 Applying ozonizer. The produced ozone purified water is sprayed on the surface of the tree, and the strong oxidation of ozone is used to kill pathogens, eggs and young nymphs, which is broad-spectrum and non-toxic. The concentration range of ozone is set by the R&D manufacturer. It will receive better application effect in closed facility fruit trees. However, it must be sprayed for many times, with an interval not more than 5 d, leading to high labor cost. Thus, it should be combined with pesticide application. It will receive little effect on open field fruit trees in an unenclosed environment. At present, ozonator is less applied in agriculture due to its high price.

plying lime sulphur twice before germination and after harvesting, spirodiclofen, azacyclotin or avermectin are used to control red spider before and after bagging. Matrine and petroleum emulsion are used to control woolly aphids and scale insects. Quicklime is broadcasted around root collar to prevent snails and slugs.

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