International Journal of Social Science and Education Research Volume 5 Issue 10, 2022
ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202210_5(10).0088

Review on the Effect of Foliar Fertilization on Yield and Quality of Cherry Tomato

Sichun Zhang[1,*]

[1]College of Life Sciences, Shanghai Normal University, 200233, Shanghai, China

[*]Email: 1000486682@smail.shnu.edu.cn

Abstract

As an important horticultural crop, cherry tomato has good taste and nutritional value. With the continuous improvement of economic level, the consumption of cherry tomatoes also increases, which will put forward higher quality and output requirements for growers. Therefore, the key to solve the problem of improving quality and yield is to apply correct cultivation techniques and methods. In this paper, the current situation of the research on the control of the yield and quality of cherry tomato by the selection of foliar fertilization and spraying period in recent years was summarized, in order to provide the cultivation means and reference for the improvement of the yield and quality of cherry tomato.

Keywords

Cherry tomato; Foliar fertilization; Yield; Quality.

1. Introduction

Cherry Tomato (Solanum lycopersicum), which can also be called Saint fruit and small tomato, belongs to a variety of tomato genus of Solanaceae and is produced in South America. It is an annual herbaceous light loving plant, which can produce ripe and juicy fruits similar to cherries and is known to the public. It is rich in calcium, magnesium, iron, zinc, lycopene, flavonoids, vitamin C and other essential nutrients and antioxidants. It is loved by people because of its wide use, good taste and high nutritional value, and is listed as one of the "four major fruits" by the United Nations Food and agriculture organization. Cherry tomato is one of the most widely planted horticultural crops in China, and the current cultivation area is about 150000hm2 [1]. The planting area in the suburbs of large and medium-sized cities and high-tech agricultural demonstration parks is increasing year by year.

With the improvement of economic level, people's consumption of cherry tomato is increasing, and at the same time, higher requirements are put forward for its quality. Fertilization is an important measure to promote the growth and yield of cherry tomato. However, in order to achieve a higher yield, the relevant agricultural workers used a large number of elemental fertilizers, which were not implemented according to the established standards, completely ignoring the actual application of trace elements, resulting in many problems to be further solved, such as low yield, low quality and environmental pollution. Therefore, it is the key to solve the problem of high yield and sustainable development of soil to choose the right way and amount of fertilization. Foliar fertilization is a method of top dressing outside the root, which directly applies nutrient elements to the surface of crop leaves, and gradually exerts its actual function through leaf absorption, playing a certain auxiliary effect. This fertilization technology has become a vital existence in modern agricultural production activities. Compared with root fertilization, foliar fertilization has the advantages of low dosage, high utilization rate, good fertilizer efficiency and environmental friendliness [2]. It not only promotes the growth and development of cherry tomato, but also improves the yield and quality. At the same time, it can

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202210_5(10).0088

also enhance the resistance of the plant, so as to alleviate the damage of various stress on the plant. In this paper, the research status of the yield and quality control of cherry tomato was expounded based on the variety selection of foliar fertilization and spraying period in recent years. It is hoped that it can provide corresponding cultivation methods and practical reference for the yield and quality improvement of cherry tomato to a certain extent.

2. Nutrient Absorption of Cherry Tomato Leaves

The leaf is the main place of plant photosynthesis. It can synthesize simple inorganic matter absorbed by the outside into organic matter, gradually convert solar energy into chemical energy, and then release the ability required by plant life activities perfectly. Cherry tomato leaves are divided into three parts, which are epidermis, mesophyll and vein. However, the epidermis is divided into upper and lower types, mainly composed of epidermal cells and stomatal apparatus. Epidermal hair is an effective protective mechanism for leaves, and will also play a corresponding protective role. The outer wall of leaf epidermis cells is mainly covered by waxy layer and cuticle. The waxy layer is distributed in the outermost layer, which is further formed by waxy secreted by epidermal cells, and the pectin layer separates the cuticle and leaf epidermis cells [3].

There are three ways for plant leaves to exchange materials with the outside world: first, through stomata on the leaf surface; The second is the hydrophilic pores in the cuticle of the leaf surface, which have the same ability to absorb the available nutrients; Finally, through the plasmodesmata of leaf cells, and actively absorb nutrients to enter the internal tissues of leaves. The waxy layer and cuticle are unevenly distributed at the junction of leaf hairs and leaves, making it easy for nutrients to permeate into the leaves from here. Among the above three ways, leaf stomata is one of the most important ways for nutrients to enter the leaf interior [4]. First, the nutrients on the leaves enter the waxy layer and cuticle through diffusion, and then gradually enter the mesophyll cells and finally be absorbed and utilized [5]. Roberts et al. [6] reported that nutrients can pass through the cuticle of the leaf positively and enter the mesophyll cells smoothly through this path. The reason is that the cuticle of the leaf surface is covered with some colloidal substances, which are converted into water-soluble nutrients, thus entering the channels inside the leaf smoothly. It can be seen that foliar fertilization can make the nutrients in the fertilizer enter the plant directly from the leaves through ingenious ways, and use two effective ways to maintain plant life, namely photosynthesis and transpiration, to jointly participate in the synthesis and release of organic matter. In this way, plants can fully absorb the nutrients of fertilizer, which also proves to a certain extent that the effect of foliar fertilization is higher than that of soil fertilization [7]. It is very important for the growth, yield and quality of cherry tomato.

3. Effects of Different Foliar Fertilizers on Growth, Yield and Quality of Cherry Tomato

Foliar fertilization, as a new type of fertilization, can supplement trace elements and glycosides necessary for crops in an efficient and rapid way, thereby enhancing the stress resistance of crops and promoting the quality and yield of crops.

3.1. Medium and Trace Elements

With the progress of agriculture and the upgrading of science and technology, the types of medium and trace element foliar fertilizers have gradually increased, and the application scope of them in horticultural crops has gradually expanded. Many experts are studying the effects of various medium and trace element foliar fertilizers on tomato growth, yield and quality. Proper application of medium and trace element foliar fertilizer can gradually regulate the production

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202210_5(10).0088

and development of plants, correspondingly increase the yield and the content of vitamin C and soluble sugar of fruits, and further reduce the content of organic acids, so that the quality of tomatoes can be significantly improved. At the same time, it can also strengthen its resistance to environmental stress. Peng Liang et al. [8] (2017) found that spraying foliar fertilizer rich in amino acids and medium and trace elements, mainly including Mn, Zn, Mg and B, could significantly improve the single fruit quality, lycopene content and vitamin C content of tomato, further reduce the nitrate content, adjust the taste of fruit, and thus significantly improve the quality of fruit. Lei Fei et al. [9] (2019) found that the four kinds of foliar fertilizers rich in medium and trace elements, Wanguo, quanbu, rare earth and yeshuang, have obvious promoting effects on the plant height, stem diameter, fruit number, leaf length, leaf width and leaf spacing of tomato plants, which are conducive to the growth of cherry tomatoes and can significantly improve the yield of cherry tomatoes. Among them, the cherry tomatoes with Wanguo (containing calcium, boron and nitrogen) foliar fertilizer have the highest yield; At the same time, the contents of vitamin C, soluble sugar and soluble solids in cherry tomato fruit were increased correspondingly, thus the content of organic acids was decreased. Li Jun et al. [10] (2011) found that Spraying Manganese leaf fertilizer with concentration ranging from 0.1% to 0.2% can improve the content of soluble sugar and vitamin C in cherry tomato fruit to a certain extent, and also effectively improve the sugar acid ratio in fruit. On the contrary, if the spraying concentration is high, the manganese leaf fertilizer will further affect the actual quality and taste of tomato fruit. Shi Ruyue et al. [11] (2021) showed that the application of medium and trace elements can improve the growth indicators such as plant height and stem diameter of tomato plants, significantly improve the quality and yield of each tomato fruit, and increase the content of vitamin C and lycopene in the fruit. The nitrate content in the fruit was reduced. Raphael et al. [12] (2019) cultivated cherry tomatoes under hydroponic conditions. Applying boron containing foliar fertilizer can maintain the yield of cherry tomatoes and have a positive impact on improving fruit quality. This indicates that the application of medium and trace element foliar fertilizer plays an irreplaceable role and value in improving tomato yield and quality.

3.2. Small Molecule Organics

Cherry tomato can directly and effectively absorb and utilize mineral nutrients, not only that, but also small molecule organic substances such as amino acids and sugars, so as to further promote the production of crops and the improvement of products and quality, and also play a certain role in the absorption of nutrients. Lei Fei et al. [13] (2019) found that the plant height, yield, soluble sugar and chlorophyll content of cherry tomato sprayed with different concentrations of chitosan oligosaccharides will be significantly improved to a certain extent. The yield and sugar acid ratio of cherry tomato sprayed with 450 mg / L chitooligosaccharide were the highest. Ding Shuangshuang et al. [14] (2015) found that compared with calcium nitrate and sugar alcohol chelated calcium, compared with calcium nitrate or sugar alcohol chelated calcium, chelated calcium fertilizer mainly from small molecular organic amino acids and supplemented by sugar alcohol is more effective in promoting calcium absorption and transport; Adding some amino acids and sugar alcohols to the organic chelated calcium fertilizer can effectively chelate calcium ions to a certain extent, so that calcium ions can be cleverly existing and transferred to plants in the form of chelated calcium by amino acids and sugar alcohols to the maximum extent. When it exists in the plant, the solubility of amino acid and sugar alcohol chelated calcium will be expanded, and there will also be obvious mobile advantages. Thus, the problem of long-distance transportation only exists in the xylem can be effectively solved, and finally the growth and nutrient absorption of cherry tomato can be promoted, and the yield and quality can be improved. Zhang Shengping et al. [15] (2015) showed that euploid bacteria fertilizer contains a variety of active enzymes and amino acids, as well as bacteria and non-toxic organic nutrients, which are beneficial to maintain the normal

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202210_5(10).0088

growth of plants, and can achieve the effect of promoting plant growth, effectively improve tomato quality, enhance flavor, increase sugar content, and reduce the degree of flesh lignification.

3.3. Glycosides, Basic Polysaccharides and Other Macromolecular Substances

Xu Sumeng et al. [16] (2015) found that spraying different concentrations of Stevia on the leaf surface had certain inhibitory effect on the growth of cherry tomato, and had no effect on the yield and single fruit weight, but the content of soluble solids, total sugar and vitamin C increased significantly. The treatment with Stevia concentration of 200 mg / L significantly increased the content of soluble solids, vitamin C and total sugar in the fruit, improved the quality of cherry tomato fruit and improved the wind feeling of tomato. Liu Jinfeng et al. [17] (2016) found that the use of chitosan has been proven to increase tomato yield and improve fruit quality and taste. It can significantly increase the content of vitamin C in the fruit, balance the acidity of tomato fruit, make it taste better, and the fruit shape of tomato treated with chitosan is more beautiful.

Oligosaccharide is also commonly called oligosaccharide. It is a new type of functional sugar source, widely distributed in living organisms, and has a close relationship with the normal growth of plants. Oligosaccharides are also regarded as signal molecules to regulate normal plant production and development, mainly including somatic embryogenesis, cell division and differentiation. Zhang Shengping et al. [15] (2015) found that qishanbao marine oligosaccharide compound preparation can effectively improve the stem diameter and plant height of tomato plants, strengthen the single plant yield of early spring protected tomatoes, and improve the content of soluble solids in tomato fruits, thus further improving the quality and taste of tomatoes.

3.4. Combined Application of Different Foliar Fertilizers

Li Ruihai et al. [18] (2008) showed that the rational combination of nutrient elements and Brassinolide (BRS) can effectively promote the growth of tomato plants, improve fruit yield and improve fruit quality. Spraying appropriate concentration of BRS and nutrients on the leaf surface can promote the absorption of N, P and K by the leaves, thereby promoting plant growth, increasing the chlorophyll content and photosynthetic rate of tomato leaves, increasing the vitamin C content and soluble sugar content in the fruit, further reducing the organic acid content, and effectively improving the quality of the fruit. Wang Zhun et al. [19] (2022) found that the combination of humic acid leaf fertilizer and polymerized amino acids deepened the absorption and utilization of trace elements, significantly enhanced the number of fruits, properly stabilized the color conversion rate, strengthened the dry weight of plants, reduced the content of nitrate, and thus increased the content of vitamin C. At the same time, the addition of two additional amino acids will have a significant impact on dry weight and quality. It can be concluded that tomato can absorb and utilize amino acids, and improve the corresponding yield and quality. Tang yuanqiang et al. [20] (2021) made use of biogas slurry extract, which contains various plant growth hormone, acid substances and active substances to improve plant stress resistance and insect resistance, and compounded it with wild Seabuckthorn endophytic fungus, Paecilomyces wannii SJ1, which can promote crop growth, root development, improve frost resistance and increase yield. Through improving some growth indicators of tomato plants, Increase tomato fruit yield. The combination of biogas slurry extract and Paecilomyces wanensis with foliar fertilizer can further replace the chemical fertilizer foliar fertilizer while ensuring the yield and quality of tomato. This can not only effectively resolve the serious impact on the environment caused by the excessive use of chemical fertilizers, but also improve the practicality and safety of products, and help promote the healthy and stable development of agriculture.

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202210_5(10).0088

Dima et al. [21] found that the combined application of selenium (SE) and yeast wine residue (BYV) containing glycine and betaine can reduce the negative effects of selenium on plants, induce tomato plants, and improve stomatal conductance and photosynthetic efficiency. Increased the accumulation of ascorbic acid, carotene, polyphenols and other substances, and improved the fruit yield.

3.5. Other Treatment Methods

Photosynthetic bacteria play a significant role in providing sufficient nutrients for the growth and development of crops. For example, it can degrade aromatic compounds and organophosphorus pesticides to metabolize into a variety of enzymes and organic acids, thereby further improving the healthy growth of plants; Rich in photosynthetic bacteria can effectively improve the photosynthesis of plants. Among them, photosynthetic bacteria fertilizer is also rich in various trace elements, which will produce a variety of vitamins and growth stimulating substances during the formation of actual microbial flora. It has obvious help and influence on promoting the production and development of roots and enhancing photosynthesis. Zhang Shengping et al. [15] (2015) found that the application of egli biological fertilizer mainly composed of photosynthetic bacteria and their secretion can effectively promote the production of tomato plants, accelerate the development of tomato plant height and stem, increase the yield of tomato fruits, and improve the content of soluble solids in tomato fruits, thus further optimizing the actual quality of tomato.

Alkaline electrolyzed water has certain emulsifying effect, especially for vegetable oil. Once the vegetable oil is emulsified, it will be evenly dispersed in the water. If the mixture is sprayed on the crops, a layer of organic film will be formed on the leaf surface, and the organic film formed in this way will play an obvious role in the control of plant diseases and pests. The wide application of this type of organic membrane in agricultural production activities will greatly improve the alkaline electrolytic water, and have a certain positive impact on the prevention and control of crop diseases and insect pests and the strengthening of the management of the electrolytic water agricultural technology system. Yi Chunyan et al. [22] (2022) found that acidic electrolyzed water can be skillfully used to disinfect seeds, which is rich in 5-10 times diluent, including hypochlorous acid, etc., and alkaline electrolyzed water can be used to promote seed germination, including 20-30 times diluent, rich in potassium ions, and also has certain surfactant characteristics. Spraying acidic electrolyzed water is beneficial to reduce the ammonia content in the cultivation environment. Electrolytic water can also be used to control tomato pests and effectively improve the quality of cherry tomatoes without causing chemical damage to tomatoes. Therefore, the quality and efficiency of cherry tomato production can be improved by using the electrolytic water agricultural technology system.

4. Effects of Different Foliar Fertilizer Spraying Periods on Growth, Yield and Quality of Cherry Tomato

Hu Chenxi et al. [23] (2020) took zheying powder No. 1 as the material to deeply explore the actual impact of foliar fertilizer spraying at different periods on the normal growth and yield of cherry tomatoes. According to the research results, compared with no foliar fertilizer (CK), foliar fertilizer spraying can effectively improve the number of fruits and the quality of single fruit. And with the spraying time moving back, the increasing range gradually increased. At the same time, spraying foliar fertilizer increased the plant height, stem diameter, leaf length and leaf width of cherry tomato, which was beneficial to plant growth. In addition, spraying foliar fertilizer also increased the chlorophyll content (SPAD value) of cherry tomato leaves, which was beneficial to enhance the photosynthetic capacity of leaves. To sum up, spraying foliar fertilizer has significant effects on improving the normal growth and development of cherry tomato plants and promoting the photosynthesis of plants. It is precisely in this way that the

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202210_5(10).0088

actual yield of cherry tomato is increased. At the same time, it was also found that the spraying effect would be more significant 21 days after the planting.

5. Conclusion

Foliar fertilization is one of the most important fertilization measures in modern agriculture, because it can not replace soil fertilization, but can only be used as an effective auxiliary measure, only providing limited use. The rational application of foliar fertilizer in cherry tomato cultivation can not only promote the growth and development of plants and improve the yield of cherry tomatoes, but also enhance the content of soluble solids, vitamin C, soluble sugar and soluble protein in tomatoes, reduce the content of organic acids and improve the quality of cherry tomatoes. In the future production, the suitable varieties and amounts of foliar fertilizer should be determined according to the cultivation technology, soil nutrient status and tomato varieties, and the application scheme should be selected according to the actual plant growth stage.

References

[1] Zheng Jinrong, Li Yanhong, Nie Jun, Tan Delong, Xie Yuming, Zhang Changyuan. Overview and research progress of protected cherry tomato industry [J]. Guangdong agricultural science, 2020, 47 (12):212-220.

[2] Wu Hui, Ma Wei, Wu Mohan, Qin Yong. Effects of Spraying Different Foliar Fertilizers on Tomato Yield and quality [J]. Northern horticulture, 2015 (9):154-157.

[3] Li Yanting, Li Xiuying, Xiao Yan, Zhao Bingqiang, Wang Lixia. Research Progress on nutrition mechanism and application of foliar fertilizer [J]. Chinese agricultural science, 2009, 42 (1):162-172.

[4] Leece D R. Foliar absorption in Prunus domestica L. I. Nature and development of the surface wax barrier [J]. Australia Journal of Plant Physiology, 1978, 5:749-766.

[5] Franke W. Mechanism of foliar penetration of solutions [J]. Annual Review of Plant Physiology, 1967, 18:281-300.

[6] Roberts E A, Southwick M D, Palmiter D H. A microchemical examination of McIntosh apple leaves showing relationship of cell wall constituents to penetration of spray solutions [J]. Plant Physiology, 1948, 23:557-559.

[7] Liu Xiao. Application analysis of foliar fertilization technology in agricultural production [J]. China agricultural information, 2014 (7):125.

[8] Peng Liang, sun Zhiming, Lu Chenghe, Tang Ming, Tang Jianzhou, Zhang Zhiyuan. Effects of plant nutrients on Tomato Yield and quality [J]. Hubei agricultural science, 2017, 56 (15):2902-2903 + 2915.

[9] Lei Fei, Tan Hao, Fu Chuanliang, Yang Chun, Gao Fanghua, Xiao Tongbin. Effect of Different Foliar Fertilizers on growth, yield and quality of cherry tomato [J]. Guizhou Agricultural Science, 2019, 47 (1):107-110.

[10] Li Jun, Liu Fengjun, Zhang Guoqin, et al. Effect of Foliar Spraying Manganese Fertilizer on tomato fruit quality [J]. Jiangsu agricultural science, 2011, 39 (6):273-274.

[11] Shi Ruyue, Wang Chong, Yang Junxue, Yu Dian, Gao Mengmeng. Integrated analysis of the effects of medium and trace elements on Tomato Yield and quality [J]. Chinese melon and vegetable, 2021, 34 (3):66-71.

[12] Melo R O, Martinez H P, Carneiro A P S. Production and quality of Sweet Grape tomato in response to foliar fertilization with boron [J]. Horticultura Brasileira, 2019(37):338-342.

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202210_5(10).0088

[13] Lei Fei, Zhang Dongming, Tan Hao, pan Xiaozhong, Wu Yujia, Liu Guobiao, Xiao Tongbin. Effect of spraying chitooligosaccharide on Yield and quality of cherry tomato and control effect of late blight [J]. Guizhou Agricultural Science, 2019, 47 (09):74-77.

[14] Ding Shuangshuang, Li Yanting, Yuan Liang, Zhao Bingqiang, Lin Zhian, Li Juan, Yang Xiangdong, Zhang Jianjun, Gao Jianchang. Effect of small molecule organic chelating calcium fertilizer on yield, quality and nutrient absorption of cherry tomato [J]. China soil and fertilizer, 2015 (5):61-66.

[15] Zhang Shengping, Che Hanmei, Li Ruxin, Zhang Shumin, Xu Zhanxin. Effects of three kinds of Foliar Fertilizers on the growth of protected tomato [J]. Northern horticulture, 2015 (21):21-24.

[16] Xu Sumeng, Li Jianshe, Ma Xiaoyan, Gao Yanming. Effect of foliar spraying Stevia on growth and quality of cherry tomato [J]. Northern horticulture, 2015 (18):48-51.

[17] Liu Jinfeng, Qi Yun, sun Mingwei, Liu Youli. Effect of Chitosan on Tomato Yield and quality [J]. Chinese fruit and vegetable, 2016, 36 (10):42-44.

[18] Li Ruihai, Xu Dabing, Huang Qiwei, Shen Qirong, Wu Hongwen. Effects of Different Foliar Fertilizers on tomato growth characteristics [J]. Chinese vegetables, 2008 (6):17-20.

[19] Wang Zhun, Cheng hongsong, Zhang Mengjun, Wang Liangliang, Guo Jingli. Effects of humic acid leaf fertilizer combined with polymerized amino acids on Tomato Growth and quality [J]. Humic acid, 2022 (03):93-98.

[20] Tang yuanqiang, Li Tao, Zhang Lili, Wang Hongyun, Cao Shoujun, Dong Taili. Effects of biogas slurry extract and pseudopenicillium Wan on Tomato Growth and fruit quality [J]. Chinese melon and vegetable, 2021, 34 (03):36-41.

[21] Dima S O, Neamtu C, Desliu-Avram M, et al. Plant biostimulant effects of baker's yeast vinasse and selenium on tomatoes through foliar fertilization [J]. Agronomy, 2020(10):133.

[22] Yi Chunyan, Xiao Wei, fan Wenrong, Xiao Shengguo, Yang qiongying. Application of vegetable oil emulsified by spraying alkaline electrolytic water under organic planting mode in Early Spring Greenhouse Cherry tomato production [J]. Changjiang vegetable, 2022 (8):25-26.

[23] Hu Chenxi, Zhang Yongji, Li Ziheng, Zhang Yunhong, Qi Jianbo, Zhang Ying, Zhou Rumei, Zhang Yongtai. Effects of different foliar fertilizer spraying periods on the growth and yield of cherry tomato [J]. Changjiang vegetables, 2020 (10):66-69.