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The Migration Characteristics of Effective Selenium in Soil in Situ

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Abstract: One of the two trace elements needed for plant growth is selenium. The transmission of selenium in soil is critical to crop absorption and food safety. This paper studies the characteristics of effective selenium transmission in soil under drip irrigation conditions. Through the combination of field experiments and indoor simulation, the distribution and change of selenium in the soil profile were monitored. The research results show that drip irrigation significantly affects the vertical and horizontal migration of effective soil selenium, forming a specific distribution pattern, and dripping water and soil type are the main factors affecting selenium transmission. This article reveals the mechanism of effective selenium transmission in Shatian Youyuan, which provides a scientific basis for accurate drip irrigation and selenium nutrition management. It is further explained that the drip irrigation system not only transports water, but also affects the distribution of selenium in the soil. Through the combination of field experiments and indoor simulation, the researchers analyzed in detail the distribution and change of selenium in the soil profile of Shatian Youyuan. The study found that under drip irrigation conditions, the vertical and horizontal migration of effective selenium in the soil was significantly affected, forming a unique distribution pattern. In addition, the research results also revealed two main factors affecting selenium transmission in the soil: dripping water and soil type. Under the conditions of different drip water and soil types, the migration law of selenium is significantly different. These findings provide an important basis for accurate drip irrigation and selenium nutrition management, which helps to improve crop yields and food safety. In a word, by studying the transmission characteristics of effective selenium in the soil under drip irrigation conditions, this paper reveals the transmission mechanism of selenium in Shatian Youyuan, which provides scientific guidance for the rational utilization and management of selenium in China's agricultural production. This will not only help to improve crop yield and quality, but also have a positive impact on food safety and human health.

1. Introduction

Selenium is a trace element with important physiological functions for both human beings and animals and plants [1]. It is also one of the indispensable nutrients for crop growth. In recent years, selenium nutrition and its enrichment in crops have attracted great attention. As the main basis of

selenium source of crops, the level of selenium content and its transport characteristics directly affect the selenium content and balanced supply of agricultural products. As a member of fruit trees, Shatin pomelo has a special demand for selenium, which can not only promote its growth, improve fruit quality, but also enhance its disease resistance [2-3]. Therefore, exploring the migration characteristics of effective selenium in Shatian pomelo orchard under drip irrigation condition is of great significance to reasonably regulate the distribution of selenium and improve the selenium content of Shatian pomelo.

The behavior and migration characteristics of selenium in soil are influenced by many factors, such as soil texture, organic matter content, pH value, and irrigation methods. In particular, irrigation mode, as a key management measure affecting soil moisture and nutrient distribution in agricultural production, has a great impact on the transport characteristics of selenium in soil [4]. Traditional irrigation methods are easy to cause uneven distribution of water and nutrients, but drip irrigation, as an efficient water-saving irrigation technology, has a particularly significant impact on the migration characteristics of trace elements in the soil due to the accuracy of water and nutrient supply [5].

The purpose of this study was to clarify the migration pattern of effective selenium and the distribution pattern of selenium in the soil [6-8]. Through field test and indoor simulation, the effect of drip irrigation on effective selenium migration in soil Se was systematically studied, and the mechanism of different water drops and soil types on effective selenium distribution in soil was explored. The study of this paper not only helps to understand the specific water management of soil effective selenium migration and change rule, but also to develop scientific selenium nutrition management strategy and accurate drip irrigation technology provide theoretical basis, and to improve the nutritional quality of pomelo fruit, food safety and contribute to the sustainable development of agriculture [9].

2. Materials and Methods

2.1 Study Area Overview and Soil Sample Collection

Selenium is a trace element essential for plant growth and development, and its deficiency or excess can negatively affect crop yield and quality. In the soil of Shatin pomelo orchard with drip irrigation, the effectiveness and migration characteristics of selenium directly determine the selenium absorption efficiency of fruit trees and the selenium enrichment level of fruit, and thus affect the nutritional value and safety of food. Therefore, it is of great significance to master the migration law of effective selenium in soil under drip irrigation for the optimization of irrigation management and the rational application of selenenin.

In this study, the migration characteristics of effective selenium in the Shatin pomelo orchard soil were systematically studied in combination with the field drip irrigation experiment and the indoor simulation test. By setting up the sampling points at different depths and continuously monitoring the dynamic change of selenium content in the soil profile, the action mechanism and influencing factors of water drop were deeply analyzed. The experimental results revealed that drip irrigation can significantly change the distribution of effective selenium in the soil, especially in the areas of high selenium concentration near the drip point. At the same time, the migration of selenium in the soil is not a vertical movement in a single direction, and the horizontal migration can not be ignored, which is directly related to the infiltration path and range of drip irrigation water in the soil.

The study also found that the drip quantity and soil type were the two main factors affecting selenium transport. Increasing drip accelerates selenium migration in the soil, but after reaching a certain extent, the migration rate decreases, showing nonlinear characteristics. However, different

soil types have different adsorption and fixation abilities of selenium, which directly affects the effectiveness and migration speed of selenium in the soil. Through these research results, this paper not only provides theoretical support for the application of drip irrigation technology in Shatin pomelo orchard, but also provides practical guidance for the nutritional management of soil selenin and food safety production.

2.2 Design and Implementation of Drip Irrigation Test

Selenium is an indispensable trace element in plant growth and development, and it is involved in many important biological processes. In the soil environment, the form and concentration of selenium directly affect the selenium absorption efficiency of plants and the selenium content of agricultural products, which is further related to human health. Therefore, it is of great practical significance to explore the migration law of effective selenium in soil under drip irrigation to guide agricultural production [11].

As a popular citrus fruit, Shatin pomelo has its own characteristics in selenium demand. In this study, the migration characteristics of effective selenium in soil were determined in situ by setting a drip irrigation system in Shatin pomelo orchard to simulate the irrigation conditions in actual production. The experiment used the time series sampling method, and the soil profile around the drip point was sampled regularly, and the effective selenium content in the samples was determined by chemical analysis method to obtain the dynamic change data of the effective selenium in the soil.

Through data analysis, it was found that drip irrigation had a significant effect on the transport of effective selenium in the soil. Specifically, under the action of the water drop, the soil effective selenium shows a certain depth of accumulation in the vertical direction, while showing a decreasing trend from the water drop point to the periphery in the horizontal direction. The formation of this distribution pattern is closely related to the size of the drip volume and the physicochemical properties of the soil. The experimental results also show that the migration of soil effective selenium is regulated by both soil pore water flow and soil particle adsorption under drip irrigation.

The study revealed the migration mechanism of effective selenium in soil under different drip volume, and pointed out that soil characteristics and drip irrigation strategies should be considered comprehensively in drip irrigation management to reasonably control the migration and distribution of selenium in the soil. This plays an important guiding role in optimizing the nutritional management of Shatin pomelo orchard, improving fruit quality and safety, and promoting the sustainable development of agriculture.

2.3 Measurement Method of Effective Selenium Content in Soil

Selenium plays an indispensable role in plant growth and human health. Measurement effective selenium content in soil and its migration characteristics in soil is important for guiding agricultural production and improving the nutritional value of crops. In this study, field experiments in pomelo orchard under drip irrigation combined with indoor simulation experiments to systematically observe and record the migration of effective selenium in the soil under drip irrigation. In the experiment, standardized soil sampling methods were used to obtain soil samples from different depths and different distances to ensure the accuracy and comparability of the data.

The experimental results revealed that drip irrigation had a significant effect on the effective selenium distribution in the soil. In the directly affected area of drip irrigation, the concentration of selenium showed a trend of decreasing with increasing depth, indicating that the effective selenium mainly accumulates in the surface layer of the soil. Meanwhile, in terms of horizontal migration, the farther away from the drop point, the soil effective selenium content gradually decreased. Moreover,

different settings of drip volume also play a decisive role in selenium migration. At higher drip levels, the effective selenium downward penetration was deeper and wider, showing a stronger vertical migration trend. On the other hand, soil type also has a significant impact on the adsorption capacity and migration rate of selenium. Due to the high porosity, sandy soil makes the migration speed of selenium accelerated, while clay soil shows a stronger adsorption capacity.

Through a thorough analysis of the transport characteristics of selenium in soil, this study found that drip irrigation technology can optimize selenium distribution in soil by regulating the drip volume and drip irrigation strategy, thus promoting the absorption of selenium by plants and increasing the selenenin content of crops. These findings have important applications for developing rational drip irrigation schemes as well as improving soil selenoin nutritional management strategies, especially in agricultural production in selenium-deficient areas. Through scientific drip irrigation management, it can not only improve the efficiency of soil utilization, but also help to improve the quality of agricultural products and food safety level, so as to have a positive impact on human health.

3. Results and Analysis

3.1 Spatiotemporal Distribution Characteristics of Effective Selenium Content In Soil

As one of the trace elements necessary for plant growth, selenium transport in soil is crucial for crop absorption and food safety. In this study, the migration characteristics of soil effective selenium were deeply explored by conducting in situ determination in Shatin pomelo orchards under drip irrigation. Under the method of fixed-point sampling and timing monitoring, the research team selected pomelo trees with different growth periods as the research object, in order to reveal the influence of different growth stages on soil effective selenium migration.

The study showed that the distribution of soil effective selenium was significantly hierarchical under the influence of drip irrigation. In the vertical direction, the effective selenium is mainly concentrated in the rhizosphere region, while its content gradually decreases with increasing depth. In the horizontal direction, due to the local water supply effect of drip irrigation, the effective selenium gathers near the irrigation point, forming a high content gradient. This distribution pattern provides a new perspective for understanding the migration of selenium in the soil and plant absorption.

The experiments further revealed the significant effect of drip quantity and soil type on selenium transport. Increasing the amount of water will accelerate the vertical migration of selenium in the soil, leading to the accumulation of selenium in deeper soil layers, and the adsorption capacity of effective selenium varies significantly between different soil a type, which changes the migration rate and final distribution pattern of selenium. For example, in clay soil, selenium moves slowly and accumulates in sandy soil, selenium is faster and prone to deep soil.

The significance of this study is that it not only provides a theoretical basis for the management of effective soil selenium under drip irrigation technology, but also has important guiding significance for the optimization of soil selenonutrient management, improving crop quality and ensuring food safety. By understanding the migration law of effective selenium in Shatin pomelo orchard with drip irrigation, agricultural producers can accurately regulate the amount of water drop and choose appropriate soil types, so as to effectively improve the absorption efficiency of selenium in crops, further promote plant growth and improve the nutritional value of fruit [12].

3.2 Influence of Drip Irrigation Conditions on Effective Soil Selenium Transport

Selenium is an essential trace element for the growth and development of crops, and it is also of

great significance for human health [8]. The availability and migration rules of selenium in soil have a direct impact on the selenium absorption of crops and the selenium content of food. In order to understand the migration characteristics of effective selenium in soil under drip irrigation, the selenium migration was studied by in situ measurement.

By setting up test groups with different drip amounts and combined with time-series soil sampling analysis, we observed obvious regularity in the migration of selenium in the soil profile. As an efficient irrigation method, water-saving drip irrigation gradually releases water into the surrounding soil through point sources, and then affects the migration of dissolved selenium in the soil. The monitoring results showed that drip irrigation could promote the vertical migration of effective selenium in the soil, especially in the close soil layer, where the selenium content increased [13]. This phenomenon may be related to the soil moisture gradient caused by dripping water, which drives the movement of the dissolved selenium.

Soil type also plays a decisive role in selenium transport. The large porosity and low water retention capacity of sandy soils lead to easier migration of drip irrigation water and dissolved selenium to deep soil. This is less pronounced in clay soils, where smaller pores and strong water retention distribute the effective selenium mainly in the shallow soil layers.

The amount of drip irrigation and soil type are important factors affecting the transport of selenium in the soil. Drip irrigation affects the distribution pattern of effective selenium by changing the soil moisture condition, and the soil type determines the rate and direction of selenium transport. These findings not only provide scientific guidance for the application of drip irrigation technology in Shatin pomelo orchards, but also provide a theoretical basis for further optimizing the selenium nutrition management strategy of crops. Through reasonable regulation of drip irrigation strategy, the absorption of selenium by crops can be effectively improved, so as to enhance the stress resistance of crops and the nutritional value of food [14].

3.3 Relationship between Growth of Pomelo and Effective Selenium Content

As one of the trace elements necessary for plant growth, selenium transport in soil is crucial for crop absorption and food safety. This paper studied the characteristics of effective selenium transport in soil under drip irrigation. The distribution and change of selenium in the soil profile were monitored by the combination of field experiment and indoor simulation. The results showed that drip irrigation significantly affected the vertical and horizontal migration of effective soil selenium, forming a specific distribution pattern, and the amount of water drop and soil type are the main factors affecting selenium transport. This paper reveals the mechanism of effective selenium transport in Shatin pomelo orchard, which provides a scientific basis for accurate drip irrigation and selenium nutrition management.

In the course of this study, we deeply analyzed the influence of drip irrigation technology on the distribution of effective selenium content in soil [7]. The effective selenium concentration in soil samples at different depths was continuously tracked using real-time monitoring techniques. It is found that under the action of drip irrigation, the distribution of selenium in the soil showed obvious hierarchy, and the selenium content in the surface soil was high, which gradually decreased with the increase of depth. This phenomenon indicates that water dripping can block the vertical migration of selenium in the soil [10].

The effect of soil type on selenium migration was also explored. Different soil texture and organic matter content have different abilities to hold and release selenium, which thus affects the effectiveness of selenium. Selenium is more likely to move in sandy soil due to its large pores and strong drainage. In contrast, tighter soil types such as clay and loam soil can better hold selenium.

As a key parameter in drip irrigation operation, drip drop volume also plays a decisive role in the

transport of selenium. Moderate drip can promote soil selenium dissolution and plant roots uptake [6]. However, excessive dripping may lead to deep penetration and even loss of selenium, thus reducing the effective selenium content in the soil surface and affecting the nutrient absorption of selenotin in Shatin pomelo.

Through the study of soil effective selenium transport characteristics in Shatian pomelo orchard, this paper has deeply understood the function mechanism of drip irrigation technology in regulating the migration of soil trace elements. These findings not only have guiding significance for improving the nutritional level of selenin in Shatin pomelo, but also provide important reference for ensuring the quality of agricultural products and food safety. In future drip irrigation management, the regulation of soil type and drip quantity should be considered to optimize the plant availability of selenium and while protecting and improving soil health.

4. Discussion

4.1 Comparison of the Migration Difference of Effective Soil Selenium under Different Drip Irrigation Conditions

As one of the essential trace elements for plant growth, the effective form of selenium in soil has a profound impact on the healthy growth of crops and human food safety. This study focused on the migration characteristics of effective selenium in the soil of Shatin pomelo orchard under drip irrigation, and explored the dynamic changes of field monitoring and laboratory simulation.

Through the collection and analysis of soil profile samples in the drip area, it was observed that the effective selenium content showed obvious spatial distribution characteristics during drip irrigation. Drip irrigation controls water application more effectively than traditional irrigation, resulting in a unique mode of effective selenium migration in the soil. In addition, the experimental results show that soil type plays a key role in the transport of effective selenium. Its large permeability makes the migration of selenium in the soil faster, while the clay soil slows down the movement of selenium due to its lower permeability.

The experiment also found that drip drop had a significant effect on effective selenium migration. The appropriate water drop can not only ensure the demand for selenium in crops, but also avoid the environmental risks caused by excessive migration of selenium. The analysis showed that the migration depth of effective selenium in the soil profile increased, but did not increase significantly after a certain range, possibly due to the adsorption in the soil and the chemical form transformation of selenium.

By adjusting the way and amount of water application, drip irrigation technology can significantly affect the migration law of effective selenium in soil, and then affect the absorption of selenium in Shatin pomelo. The findings of this study are important for understanding the mechanism of selenoin transport under drip irrigation conditions and provide a scientific basis for selenoin nutrition management and environmental risk assessment of soil selenoin. Future work can further explore the combined effect of different soil conditions and drip irrigation management measures on SenE migration and crop absorption to optimize the SenE management strategy under drip irrigation system.

4.2 Explore the Mechanism of Drip Irrigation on Selenium Absorption and Accumulation in Shatin Pomelo

As one of the trace elements necessary for plant growth, selenium transport in soil is crucial for crop absorption and food safety. This study focuses on the characteristics of effective selenium transport in the soil under drip irrigation. The distribution of selenium in the soil profile was

monitored in detail by field experiment and indoor simulation. Different soil types and drops were selected to explore how these factors affect selenium absorption and migration.

The results showed that the content of effective selenium varied at different depths under drip irrigation, with the highest content in the soil layer near the drip point. This phenomenon indicates that drip irrigation can promote the vertical migration of selenium in the soil and concentrate in the rhizosphere region, facilitating the root uptake of Shatin pomelo. Moreover, the horizontal migration of effective selenium in the soil was more significant with the increase of drip water, which is important for understanding how drip irrigation affects the distribution of selenium present in the surrounding soil.

Further analysis found that the soil type also played a decisive role in the migration and absorption of selenium. Due to the high porosity of light sandy soil, water and selenium are more likely to penetrate downward, while clay soil is limited in the migration of selenium in the soil layer because of its small pores and strong water retardation. Therefore, Shatin pomelo orchards with different soil types need to adjust drip irrigation strategies according to their soil characteristics to maximize selenium absorption efficiency.

By studying the effective transport characteristics of soil selenium under drip irrigation, this paper reveals the mechanism of drip irrigation on the absorption and accumulation of selenium in Shatin, and provides important information about the design and management of drip irrigation system. These findings will help to optimize drip irrigation technology to ensure selenotin nutrient supply for crops such as Shatin pomelo, while also providing a reference for trace element management in other crops under similar conditions.

4.3 Evaluation the Application Prospects of Drip Irrigation System in the Management of Selenium-Enriched Orchards

Selenium is a trace element crucial for plant growth and development, which not only affects the growth quality of crops, but also is directly related to the nutritional value and safety of food products. In agricultural production, the availability and availability of selenium is often influenced by soil characteristics and irrigation methods. In this study, Shatin pomelo orchard widely used in drip irrigation technology was selected as the research object to explore the migration law of effective selenium in the soil under drip irrigation.

Using the combination of field monitoring and indoor simulation, the soil profile of pomelo orchard under drip irrigation system. By accurately determining the content of effective selenium in soil, we not only evaluated the effect of drip irrigation on the effective selenium distribution, but also analyzed the migration dynamics of selenium in the soil profile. It was found that the concentration and distribution pattern of effective selenium in soil showed obvious changes under drip irrigation. Compared with traditional irrigation, drip irrigation can promote the vertical migration of selenium in the soil and form an enrichment area at a certain depth, which is of great significance for the selenium absorption of Shatin pomelo.

Further analysis showed that the drip amount played a decisive role in soil effective selenium migration. When the drop volume increased, the depth and range of soil effective selenium migration also increased, possibly due to the dissolution and diffusion of selenium. At the same time, different types of soil have different selenium retention and release capacity, which affects the migration characteristics of selenium under drip irrigation [15].

Drip irrigation technology shows obvious advantages in regulating the distribution and migration of selenium in the soil of Shatin pomelo orchard. The results of this paper help to further understand the soil environmental chemical behavior of selenium under drip irrigation, and have important guidance for developing reasonable drip irrigation management strategies and improving the

nutritional value of selenium-enriched fruits. Future studies will further explore the impact of different drip irrigation patterns on selenium transport and how selenium soil management can be optimized by drip irrigation technology to achieve the dual goal of selenium enrichment and efficient crop absorption in orchards [11].

5. Conclusion

In this study, using field experiments combined with indoor simulation, we revealed the migration characteristics of soil effective selenium measured in situ under drip irrigation, and found that drip irrigation significantly affected the distribution of effective selenium in the soil, and its migration characteristics were strongly affected by the amount of water drop and soil type [8]. The results provide an important scientific basis for precision drip irrigation technology in improving the nutritional management of selenin and ensuring fruit quality, and have certain reference value for promoting the wide application of drip irrigation technology in agricultural production [10].

However, this study also has some limitations, such as it is difficult to accurately control all environmental factors that affect the effective selenium migration of soil under field conditions, and only involved specific soil types and drip irrigation patterns, failing to fully cover the diversity of soil conditions and irrigation methods in different regions. Future studies can be further extended to different regions, different soil types of soil and diverse drip irrigation conditions to provide a more comprehensive understanding of the laws and mechanisms of effective selenium transport in soil. In addition, for effective selenium and other trace elements interaction, long-term drip irrigation on the influence of soil physical and chemical properties and accurate drip irrigation technology in the actual agricultural production application effect and economic analysis can also be used as the direction of follow-up research, in order to agricultural sustainable development and food safety to provide more comprehensive and practical scientific research support.

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