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A Review on the Influence of Medium and Trace Elements on the Quality of Agricultural Products

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Abstract

In recent years, soil salinization has become a serious problem in the global environment. The application of organic fertilizer to improve saline-alkali soil has been widely concerned because of its advantages of improving soil fertility, improving soil structure and improving soil salt ion composition. This paper reviews the mechanism of saline-alkali soil improvement, and expounds the improvement prospect of organic fertilizer on saline-alkali soil from the influence of organic fertilizer on soil physical and chemical properties, water and salt transport law, crop yield and quality, in order to provide theoretical guidance for saline-alkali soil restoration.

Keywords

Salinization; Organic Fertilizer; Water and Salt Transport; Saline-alkali.

1. Introduction

Although there are dozens of elements in healthy plants, there are few nutrients necessary for plant growth. They need to meet three conditions [1]: (1) This element is indispensable for plants to complete their life cycle; (2) After the lack of this element, plants will show unique symptoms, and no other chemical element can replace its role; (3) This element does not play an indirect role by improving the environment, but must be directly involved in plant metabolism. Based on these three criteria, the nutrient elements necessary for plant growth include 17 elements. According to the amount of absorption of these 17 elements by plants, these elements are subdivided into macro elements, medium elements and trace elements. The major elements are C, H, O, N, P, K, the medium elements [2] are Ca, Mg, S, and the trace elements are Fe, Mn, Mo, Zn, Cu, B, Cl, Ni. Soil is the main source of crop mineral nutrition [3]. Various nutrients required by crops throughout the growth cycle are mainly obtained through soil [4]. The medium and trace elements in soil are called available or available content and fixed state according to whether they can be absorbed and utilized by crops. Whether the content is lacking is mainly determined by the content of available trace elements. Due to the intensive use of chemical fertilizers in intensive agricultural production, crops continue to carry out the necessary nutrients used, and the medium and trace elements are often not replenished in time, resulting in a decreasing trend in the content of medium and trace elements [5]. According to the survey [6], the content of trace elements that can be absorbed in the soil is about l/4 ~ l/2 of 50 years ago. The content of trace elements in crops produced from low content of trace elements in soil is also relatively low. In different soil environments, the contents of various

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trace elements are also very different [7]. The northwest of China is mostly calcareous soil, and the contents of available zinc, boron, molybdenum and iron are deficient to varying degrees.

2. The Relationship between Calcium and Crop Quality

2.1. The Speciation of Calcium in Soil

Calcium in soil exists in four forms: water-soluble, adsorption-exchangeable, organic, and mineral. Water-soluble calcium and exchangeable calcium are available calcium that can be used immediately by crops.

2.2. The Role of Calcium in Crops

Calcium can improve the stability of membrane structure by bridging phosphate with phospholipids and hydroxyl groups of proteins. Calcium has the function of maintaining the structure of plant cell wall, which can effectively prevent the decay of mature fruits during postharvest storage, so as to improve the storage quality of fruits. Calcium is a second messenger that regulates multiple functions of cells. It participates in signal transduction in plants through changes in its concentration in cytoplasm. Calcium can neutralize some acids produced in the metabolic process of plants and prevent excessive organic acids from poisoning cells.

2.3. The Effect of Calcium on Crop Quality

Calcium deficiency in plants can cause physiological disorders and produce a series of diseases, such as apple bitter pit, water heart disease, internal collapse disease, and softwood spot disease. Black heart disease of pear ; Chinese cabbage, lettuce dry heartburn; umbilical rot of tomato and pepper ; cabbage heart rot, potato brown spot, celery black heart disease, etc.

3. The Relationship between Magnesium and Crop Quality

3.1. The Speciation of Magnesium in Soil

Magnesium in soil mainly exists in three forms: matrix magnesium, replaceable magnesium and water-soluble magnesium (magnesium in soil solution). Matrix magnesium is the main component of magnesium in soil, but it exists in the mineral lattice and is not easy to be absorbed, while exchangeable magnesium and magnesium in soil solution are mobile and easy to be absorbed by plants, which is called effective magnesium.

3.2. The Role of Magnesium in Crops

Magnesium is the mineral component of phytohormone and chlorophyll. Magnesium is the most active component in the process of plant metabolism. It is the basic element of many enzymes and is indispensable for the formation of protein and starch in plants. Magnesium promotes the absorption and transport of phosphorus in plants，and promotes the metabolism of sugar and energy in plants.

3.3. The Effect of Magnesium on Crop Quality

Magnesium deficiency in potato will lead to chlorosis of leaves, browning, necrosis and shedding, and the growth of roots and tubers will be hindered. Magnesium deficiency in tomato will cause yellowing, and the fruit will fade from red to light orange. Magnesium deficiency in maize will appear pale yellow stripes between the veins of the lower leaves, which will become white stripes. When there is an extreme lack of magnesium, the tissues between the veins will dry up and die, showing purplish red spotted leaves and the color of the new leaves will become lighter.

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4. The Relationship between Iron and Crop Quality

4.1. The Speciation of Iron in Soil

Iron in soil is divided into inorganic iron and organic iron. Inorganic iron includes water-soluble iron, mineral iron and exchangeable iron. Soil available iron can be used as an indicator to measure the level of soil iron supply, which includes water-soluble iron, substitutional iron and a part of complex iron released by organic matter.

4.2. The Role of Iron in Crops

Iron is involved in the metabolism of RNA, the formation of light traps and chlorophyll in chloroplasts. When iron is deficient, sugar and protein synthesis and nitrogenize activity is inhibited, chlorophyll is significantly reduced, and chloroplast structure is affected or destroyed. Iron is involved in photosynthetic phosphorylation and respiration, directly involved in the reduction process of CO_2, and iron also affects other redox systems in photosynthesis, transpiration of plant leaves and stomatal opening and closing, so as to affect the whole photosynthesis process.

4.3. The Effect of Iron on Crop Quality

Apples and pears will appear ' withered shoot ' phenomenon under iron deficiency. Peach tree iron deficiency 'white leaf disease'/ 'yellow leaf disease', middle and late fruit development is blocked, small size, light color, taste light and not sweet. Iron deficiency in citrus caused the top leaves to fall off and the branches to form 'bare stems'. The fruit is small, hard and rough, and often appears abnormal fruit. The color becomes light and the taste becomes sour.

5. Conclusion

Medium and trace elements are one of the important factors to enhance crop disease resistance, regulate the flavor of agricultural products and promote the synthesis of nutrients in agricultural products. Due to the complete nutrient content of organic fertilizer, there are not only large and medium elements such as nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, but also trace elements such as copper, zinc, iron, manganese, sugar, fat and other nutrients. It is a good supply source of medium and trace elements. Reasonable application of organic fertilizer can not only increase crop yield, but also improve the nutritional quality, taste quality and appearance quality of crop products, and improve food hygiene (such as reducing nitrate content).

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