Research on the Effect of Tomato Straw Returning on the Soil Micro Environment

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Abstract: With the disadvantages of traditional crop cultivation methods, such as chemical fertilizer, and the environmental problems caused by crop straw treatment, it is of great significance to study the effects of tomato straw returning directly to the field and compost returning to the field on the soil micro environment of cucumber. In this paper, the function and effect of returning tomato straw to the field were verified by comparative test. The results showed that returning crop straw and stubble to the field was an effective measure of soil organic fertilization.

Introduction

Tomato is one of the largest vegetable crops planted and consumed in the world, but most of its straw is piled up and discarded at will, which not only pollutes the environment, but also causes a lot of waste of resources. However, there are allele-chemicals in the decomposition of tomato plant residues, which makes it difficult to use tomato straw directly. In the process of straw composting, the high temperature can decompose the allele-chemicals and reduce their allelopathy, so tomato straw can be used as substrate and fertilizer after high temperature composting. In fact, straw bioreactor and microbial fertilizer have achieved good results in the production of protected vegetables in many areas. Therefore, it is of great practical significance to carry out the continuous impact on the physical and chemical properties of soil, the functional diversity of soil microorganisms and the impact on the soil micro environment after returning tomato straw to the field.

1. Test Materials and Methods

1.1 Test material

The tomato straw used in this experiment is the waste straw after pulling seedlings in greenhouse. After one month (30 days) drying treatment in summer 2018, it will be crushed into about 1.5cm pieces. Secondly, some tomato fragments were added with bacterial fertilizer with total bacteria number $\geqslant 10^9$ CFU · g^{-1}, which was used as a reserve after composting. The characteristics of the selected test materials are shown in Table 1 below.

Table1. The characteristics of the selected test materials

Items	Total nitrogen g · kg^{-1}	Total phosphorus g · kg^{-1}	Total potassium g · kg^{-1}	Total organic carbon g · kg^{-1}	C/N
Straw	14.40	2.47	22	419	28.71
Bacterial	15.28	5.64	29	233	16.89

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1.2 Test method

Tomato cultivation was carried out in the solar greenhouse, and the experiment was carried out for two years from 2018 to 2019. The basic physical and chemical properties of cultivated soil in greenhouse are shown in Table 2 below

Table2. Basic physical and chemical properties of cultivated soil

No.	Items	Properties
1	pH value	6.20,
2	Conductivity value	0.79 MS / cm
3	Mass fraction of organic matter	21.8 g / kg
4	Mass fraction of total nitrogen	1.31 g / kg
5	Effective phosphorus content	72.8 mg / kg
6	Mass fraction of available potassium	440 mg / kg

There are 4 treatment processes in the test, as shown in Table 3 below.

Table3. The test treatment processes

No.	Process	Treatment
1	CK	Conventional cultivation
2	T1	Application of microbial agent
3	T2	Built in straw bioreactor: straw + fermentation furrow agent + chicken manure
4	T3	Built in straw bioreactor + microbial agent: straw + fermentation furrow agent + microbial fertilizer + decomposed chicken manure

The experiment was repeated and arranged randomly. The wide narrow row and high border cultivation was adopted in each test block area. Film mulching cultivation: cucumber seedlings with the same growth were planted; microbial agents and organic fertilizer were applied to the soil. The total amount of base fertilizer applied in all treatments was 6 t of mature organic fertilizer. In the later stage, each treatment applied 15 kg of urea and compound fertilizer with irrigation water in the way of furrow irrigation under the film every 21 days on average. The branches were pruned and branched regularly, and other cultivation and management measures were consistent.

Figure 1 shows the built-in straw reactor. The furrow is dug under the cultivation border to be treated, and corn straw is evenly laid at the bottom of the furrow, on which the rotten organic fertilizer and straw fermentation furrow special microbe are spread. Repeat the above operations until the straw is filled in the furrow, the straw is exposed at both ends of the furrow for ventilation, and finally the cultivation soil is covered on the upper part, and the cultivation border is made. After the straw is poured through with large amount of water, the hole is drilled on the planting hole with steel bar, and the depth of the hole is suitable to penetrate the straw layer. T1 treatment is to spread microbial fertilizer on the cultivation border according to the dosage, and use the ploughing method to turn and bury it in the ploughing layer, which is the same as other treatments.

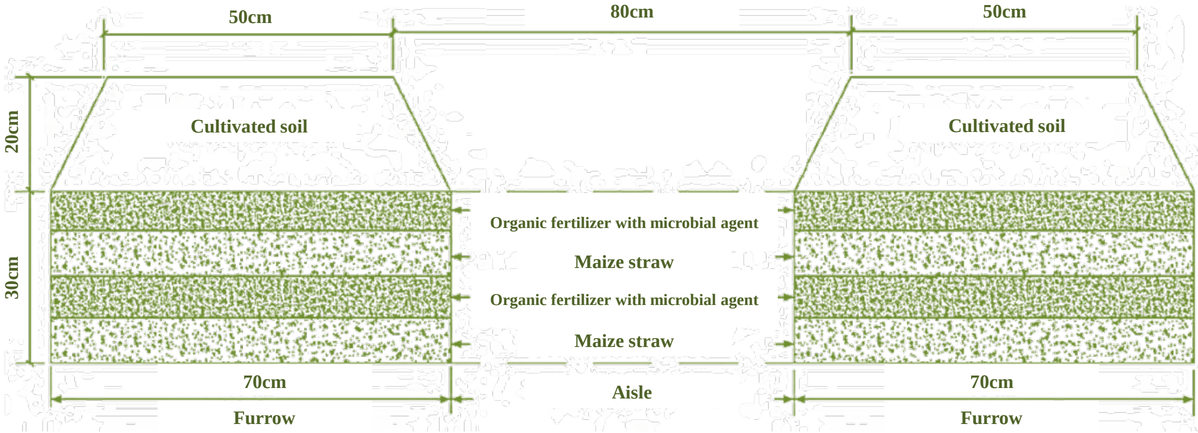

Figure1. The structure of the built-in straw reactor

1.3 Soil sample collection and analysis

Soil samples were taken within 4cm of tomato root system at vegetative growth stage, early fruiting stage, full fruiting stage and late fruiting stage. A part of the soil samples taken were screened, and the soil samples less than 1.5mm were obtained and placed in the environment of −15 ℃ for the determination of microbial related indicators. Take another part of soil sample and air dry it, and determine its pH value, EC value, organic matter, available phosphorus, available potassium and other contents. The determination method of soil physical and chemical properties is shown in Table 4 below.

Table4. The determination method of soil physical and chemical properties

No.	Items	Determination methods
1	Soil moisture content	Determination of soil moisture
2	Soil organic matter	Potassium dichromate volumetric method
3	Soil microbial biomass carbon	Microwave radiation method
4	Microbial biomass nitrogen	Ninhydrin colorimetry

2. Test Results and Analysis

2.1 Effects of different treatments on soil nutrients in different growth stages of cucumber

As the essential carbon and nitrogen sources of soil microorganisms, soil organic matter is an important index of soil fertility. According to the test results, it can be seen that during the continuous planting period, the change trend of soil organic matter of each treatment is relatively stable, and the organic matter content of each treatment is increased compared with that of the basic soil sample, but the change range of each treatment with the year is not large. The results showed that there was no significant effect on the content of soil organic matter, straw bioreactor and two measures could significantly increase the content of soil organic matter.

2.2 Effects of different treatments on soil microbial biomass

As an important part of soil organic matter, soil microbial biomass is the main driving factor of soil nutrient transformation and cycling. The change trend of soil microbial biomass carbon and soil microbial biomass nitrogen content was similar under different treatments. The soil microbial biomass carbon and nitrogen content of each treatment was higher during the vegetative growth period of cucumber, and the content decreased from the peak to the end of the result. The results showed that T1 treatment had no significant effect on soil microbial biomass carbon and nitrogen content. In addition, straw bioreactor treatment can effectively improve the soil microbial biomass in the early growth stage of cucumber, which is mainly due to the high activity of microorganisms in the decomposition process of straw reactor in the early growth stage of cucumber. At the same time, the decomposition process of straw also provides a large number of carbon and nitrogen sources for the growth and reproduction of microorganisms. These metabolic substrates stimulate the growth and reproduction of microorganisms, thus assimilating organic substrates into their own cell materials. Therefore, straw bioreactor measures can significantly improve the soil microbial biomass carbon and nitrogen content.

Conclusions

It can be seen from the test results that the tomato straw bioreactor can improve the soil structure, and increase the content of organic matter and soil microbial biomass in the soil. However, the microbial fertilizer increased the inorganic nutrients in the soil and decreased the microbial biomass. Therefore, it can be said that the technology of returning tomato straw to the field can reduce the waste of agricultural resources, improve the important sources of carbon and nitrogen in the soil, and improve the content of organic matter in the soil, so returning crop straw and stubble and other residues to the field is an effective measure of soil organic fertilization.

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