Effect of Organic Ecological Soilless Culture Substrate on Tomato Fruit

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Abstract: Based on agricultural biomass resources and utilization in Shaanxi province, this experiment used decomposing mushroom residues, pine needles, and peanut shells compounded with river sand as organic cultivation substrates, compared with garden soil, and carried out pot experiments to study the effect of different soilless cultivation substrates on tomato yield, size and number. The results show that compared with CK1 (garden soil) and CK2 (decomposed fungus residue: river sand = 1:1, volume ratio), the yield of greenhouse tomato of T5 (decomposed fungus residue: pine needles: peanut shells: river sand = 1:1:1:1, volume ratio) can be significantly improved; under the same amount of decomposed fungus residue and river sand, adding peanut shells has a better effect on tomato yield than adding pine needles; different treatments have little effect on the average height of tomato fruit, but have a greater effect on the cross diameter of the fruit.

Keywords: Soilless Culture Substrate; Organic Ecological; Tomato fruit

1. Introduction

Tomato is one of the main vegetables ultivated in facilities in China. It has the characteristics of high yield and efficiency, and is rich in nutrients such as vitamin C and lycopene [1-3]. In order to pursue high efficiency in agricultural production, farmers blindly invest excessive amounts of water and fertilizers, resulting in soil compaction, salinization, aggravation of soil-borne diseases, decline in yield and quality, and environmental pollution [4-6]. Organic ecological soilless culture technology not only has the characteristics of general soilless culture, such as improving crop yield and quality, reducing pesticide usage, product cleanliness, water saving, fertilizer saving and labor saving, etc.[7-8] Cultivated land to grow vegetables can effectively reduce production costs and reduce environmental pollution [9-12]. Based on the agricultural biomass resources and utilization foundation in Shaanxi, this experiment used decomposed mushroom residue, pine needles and peanut shells compounded with river sand as the organic cultivation substrate, and compared it with the garden soil to study the growth effect of tomato fruit, providing scientific basis and technical reference for the development of facility tomato cultivation in arable land and soil degradation areas and the full utilization of local agricultural waste resources.

2. Materials and methods

2.1 Test material

The organic matrix materials such as decomposed mushroom residues, pine needles, peanut shells, and river sand were purchased from natural nutrient soil supply stores; the pastoral soil and was used as the control group, which was collected from the Qinling Field Monitoring Center Station. Other test materials such as urea, superphosphate, potassium sulfate, and organic compound fertilizer were all collected from Yangling Agricultural Supply and Marketing Station. The tomato variety was selected from the potted cherry tomato variety, which was purchased from Yangling Agricultural Supply and Marketing Station.

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2.2 Test design

A total of 7 treatments were used in this experiment, and each treatment was repeated 3 times, as shown in Table 1. The experiment was set up in the solar greenhouse of Qinling Field Monitoring Center Station, and the flower pots of the same size were artificially filled according to the hierarchical structure of 10 cm gravel and 20 cm substrate with different ratios from the bottom to the surface. Urea (23.7g/m2), diammonium phosphate (26.7g/m2) and potassium sulfate (20.25g/m2) were applied as base fertilizers into different cultivation substrates. The trials were sown in early July 2020 and harvested in late November. The same number of tomato seeds are sown in each pot, and the seedlings are thinned according to the size and growth of the seedlings, and one seedling is fixed in each pot.

Table 1 Experiment design

Treatment	Materials (volume ratio)
CK1	pastoral soil
CK2	decomposed fungus residue: river sand=1:1
T1	decomposed fungus residue: pine needles: peanut shells: river sand =1:0:1:1
T2	decomposed fungus residue: pine needles: peanut shells: river sand =1:1:0:1
T3	decomposed fungus residue: pine needles: peanut shells: river sand =2:1:0:1
T4	decomposed fungus residue: pine needles: peanut shells: river sand =2:0:1:1
T5	decomposed fungus residue: pine needles: peanut shells: river sand =1:1:1:1

2.3 Sample determination and analysis

At harvest, the number and total yield of each tomato fruit were determined, and the cross diameter, fruit height and single fruit quality were determined. The experimental data were analyzed and plotted using Excel 2010 and SPSS 17.0.

3. Results and analysis

3.1 Differences in tomato number and yield in different treatments

Organic cultivation substrates provide certain nutrients and environment for tomato growth and development. Figure 1 shows that under the environmental conditions of this experiment, the number of fruits in different treatments from large to small is T4>T5>T1=CK1>T2>T3=CK2, the maximum number of T4 is 16, and the minimum of CK2 and T3 is 7. The total yield of fruit was T5>T1>CK1>T4>CK2>T2>T3 in descending order. The total yield of T5 tomato was 25.95g at most, and the minimum was 8.61g in T3. On the whole, compared with CK1 (pastoral soil treatment) and CK2 (decomposed fungus residue: river sand = 1:1), the T5 formula (decomposed fungus residue: pine needles: peanut shells: river sand = 1:1:1:1) can significantly improve the greenhouse tomato yield. Compared with CK2, under the same amount of decomposed fungus residue and river sand, adding peanut shells has a better effect on tomato yield than pine needles. Compared with T1 and T4, T2 and T3, the number and yield of tomatoes did not increase with the increasing volume proportion of decomposed mushroom residues, but decrease, indicating that the proportion of bacterial residue is not as high as possible.

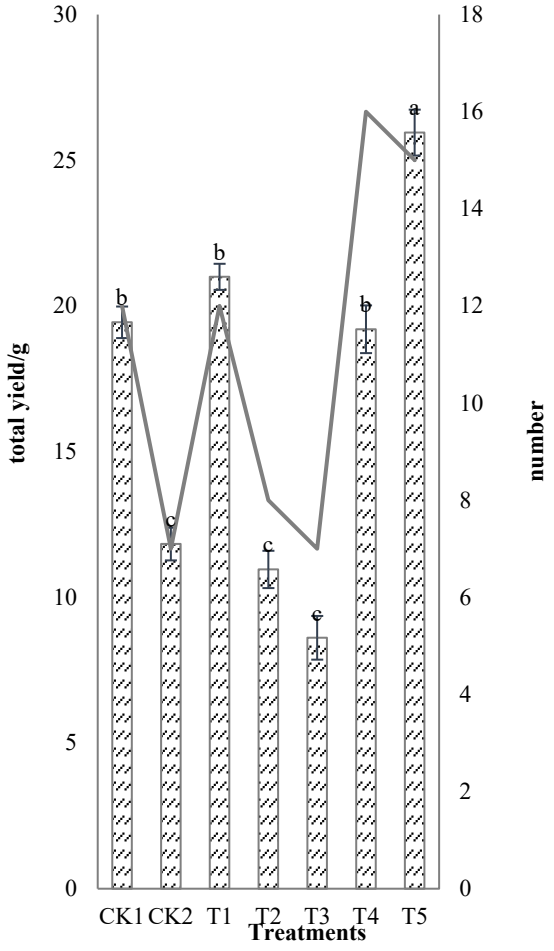

Figure 1 Total yield and number of tomato with different treatments

3.2 Differences in fruit size and single fruit quality among different treatments

Under the conditions of the solar greenhouse in this experiment, the average fruit transverse diameter of different treatments is T5>CK1=T1>T4=CK2>T2>T3 in descending order, the maximum tomato transverse diameter is 1.72cm, and the minimum is 1.29cm. The average height of tomato was T4>T5>CK1>T1>CK2>T2=T3 in descending order. The average height of tomato was 1.36 cm and the smallest was 1.22 cm. In addition, the average fruit weight of T1 treatment was the largest 1.75g, followed by T5 treatment was 1.73g, and the other treatments were all less than 1.70g. On the whole, compared with CK1 (pastoral soil treatment) and CK2 (decomposed fungus residue: river sand = 1:1), different treatments had little effect on the average height of tomato fruit, but had a greater effect on the transverse diameter of tomato. Except for the T5 formula (decomposed fungus residue: pine needle: peanut

shell: river sand = 1:1:1:1), the transverse diameter of greenhouse tomato was greatly improved, and the other formulas had no significant effect on tomato size. This is different from the effect of each treatment on the total yield, indicating that each treatment has no significant effect on the fruit quality, and the total tomato yield is mainly affected by the increase of tomato number.

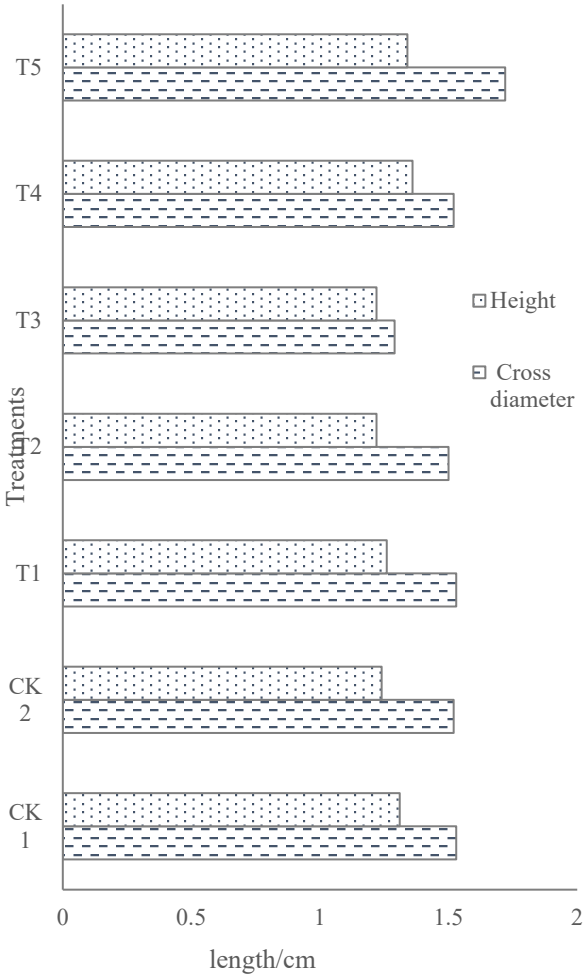

Figure 2 Variation of cross diameter and height of tomato in different treatments

4. Conclusion

Pot experiments show that, compared with loess, organic ecotype soilless culture medium can provide nutrients and environment for tomato growth and development. Under the test condition, compared with CK1 treatment and CK2 (decomposed fungus residue: river sand=1:1), the T5 formula (decomposed fungus residue: pine needle: peanut shell: river sand=1:1:1:1) can significantly improve the greenhouse tomato yield. Under the same amount of decomposed fungus residue and river sand, adding peanut shells had a better effect on tomato yield than adding pine. Different treatments had little effect on the average height of tomato fruit, but had a greater effect on the transverse diameter of the fruit.

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