Soil Cover With Organic Mulch and Its Influences on Soil Physical Parameters (Ⅱ)
——Change of Soil Porosity Under Organic Mulch Cover

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Abstract Soil porosity represents the void spaces of soil, together with moisture content, determines the air content of soil, then influences the soil processes and plant growth. Under soil cover with organic mulch the soil porosity can be regulated for improving soil physical properties. Through field experiment the changes of soil porosity under different thickness of organic mulch were investigated and the results showed that on soil surface layer from 0 to 5 cm soil depth the average soil porosity was decreased in comparison with a bare soil, while the covers increased soil porosity in soil layer from 5 to 20 cm soil depth.

Key words Soil cover Organic mulch Soil porosity

有机物覆盖地面对土壤物理因素影响的研究(Ⅱ)
——有机物覆盖对土壤孔隙度的影响

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提 要 土壤孔隙度表明土壤中空隙的体积,与含水量一起共同决定土壤中空气的含量,进而影响土壤中各种变化的进程和作物的生长。利用有机物覆盖地面可影响土壤孔隙度的变化并改善土壤的特性。通过田间实验,确定了在不同厚度有机物覆盖层下土壤孔隙度的变化。与无覆盖对照处理相比,有机物覆盖使0至5 cm 土壤表层的孔隙度降低,却使5至20 cm 土壤层的孔隙度增加。

关键词 地面覆盖 有机覆盖物 土壤孔隙度

1 Introduction

Soil porosity represents the soil cavity which is filled up by water and air. This cavity originates in the connection with different kinds of soil, the soil structure, the soil cultivation and the chemical, biological and physical processes in the soil. It influences not only moisture content, air content and thermal energy content in the soil but also biological ac-

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tivity and development of the soil[1~3]. The change of soil porosity is caused by forces acting on the soil such as soil cultivation with machinery and natural processes like drying, shrinking and swelling. Soil cultivation is a method to increase soil porosity and the travel of machinery causes decrement of soil porosity. The measures to maintain soil porosity after soil cultivation consist in conservation of soil structure through reduction of machinery travel in the field, promotion of soil activity and protection of soil surface condition. The cover of soil with organic mulch improves soil texture and affects soil processes through its influences on moisture content and temperature of the soil, which will benefit the development of soil porosity with the purpose that an optimal condition for rational air exchange in soil can be established for the needs of plant growth[4, 5].

2 Material and Method of Experiment

2.1 Organic Mulch and Experiment Treatments

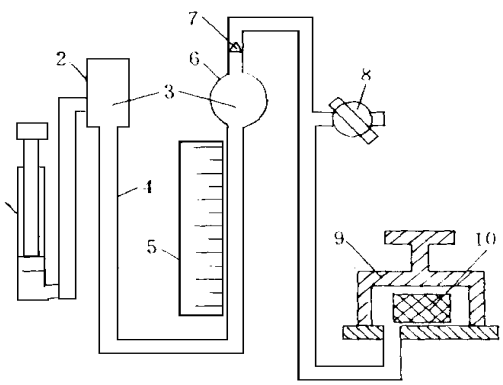
The organic mulch used was compost made from agricultural waste materials and had 42.9 % moisture content (wet basis). The influence of compost cover on soil porosity is affected by the width and thickness of cover layer. By field experiment a cover band with 100 cm width and 300 cm length was selected, the thickness of cover layer was 10, 20 and 40 mm, and a control without cover was arranged for comparison of cover effect. Each treatment had 3 replications. The experiment was carried out on a sandy loam soil in the experiment field of University Bonn, FR Germany.

2.2 Measurement of Soil Porosity

For measurement of porosity the soil samples were taken from the middle of cover band in 5 cm steps until to 20 cm soil depth with a steel cylinder knife. The cylinder shape soil sample was 5.05 cm in diameter and 5 cm in height and had a volume of 100 cm^3. The Soil sample was measured in field with an air pycnometer (Fig. 1) for its air volume (V_a), after drying soil samples the water volume (V_w) was determined and the soil porosity (e, %) was calculated as follows:

$$e = (V_a + V_w) / 100 \quad (\%) \qquad (1)$$

The measurement began at June 11th, 1992 after 31 days of covering until to August 30th, 1992, and the measure interval was 3 weeks.



1. air pump 2. levelling bottle 3. mercury 4. levelling pipe 5. measuring scale 6. manometer tube 7. stop valve 8. deaeration valve 9. vacuum cap 10. sample

Fig. 1 Schematic construction of air pycnometer

The effect of soil cover on porosity was calculated according to the porosity under the cover (e_{uc}) and without cover (e_{wc}). The relative effect of cover (E_e, %) was defined as follows:

$$E_e = [(e_{uc} - e_{wc}) / e_{wc}] \times 100 \qquad (2)$$

The statistical calculation was carried out with variance analysis for different treat-

ments, when there was a significant difference (α= 0.05), a multiple comparison with LSD-test was done[6,7], and the results were signed as a short line under the term $GD_{5\%}$ in the figures[8].

3 Results and Discussion

3.1 Changes of Soil Porosity

The change of soil porosity is a slow process that depends one side on natural conditions such as rainfall and soil settlement which decrease soil porosity, and other side on changes of soil temperature and biological activity which make soil loose and increase soil porosity. These two processes affect the soil changes interactionly and determine the soil porosity together.

The results of experiment showed that in a short period such as 21 and 42 days after cover the change of soil porosity was not significantly to define, and the effect of soil cover was not uniformly to demonstrate. Therefore, the changes of soil porosity after 67 and 100 days of cover were selected to characterize the effect of compost covers on soil porosity, the results are shown in Fig. 2 and Fig. 3.

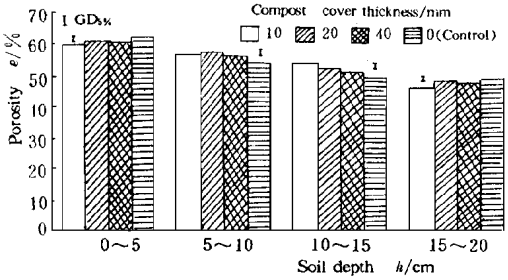


Fig. 2 Soil porosity after 67 days of cover

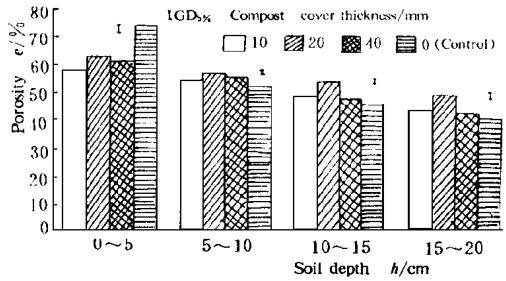


Fig. 3 Soil porosity after 100 days of cover

After 67 days of cover, the soil porosity in soil layer from 0 to 5 cm and from 15 to 20 cm soil depth was decreased under compost covers (Fig. 2). On soil surface layer from 0 to 5 cm depth the soil temperature under the covers was significantly decreased and the soil activity was reduced, so that the loose process in soil was regarded. In soil layer from 15 to 20 cm depth the covers had no significant influences on soil process because of soil damping function. In 5 to 15 cm soil depth the soil porosity was increased significantly under compost covers, here the covers created a suitable soil condition for biological activity and made soil structure loose, so that the covers led to the increment of soil porosity.

At the end of experiment the soil porosity was increased significantly from 5 to 20 cm soil depth (Fig. 3). But on soil surface layer from 0 to 5 cm depth the soil porosity was de-

creased significantly under the covers because of the reduction of soil activity due to decrement of soil temperature.

3.2 Effect of Compost Cover on Soil Porosity

For demonstrating effect of compost cover on soil porosity the relative effect (E_e) was calculated from the results of measurement and the mean value is shown in Tab. 1.

Tab. 1 Relative effect of compost cover on soil porosity

Soil depth /cm	Relative effect/%		
	Compost cover thickness		
	10 mm	20 mm	40 mm
0～5	-4.5	-5.3	-0.2
5～10	+3.8	+2.6	+3.7
10～15	+6.7	+5.6	+3.9
15～20	+4.7	+7.0	+4.9

4 Conclusions

The change of soil porosity is a complicated process which depends on soil structure and environmental influences under natural cultivation system. Under natural conditions the cover of soil with organic mulch material can affect soil porosity through its effect on soil processes. The experiment with compost as mulch showed following results:

1) On soil surface layer from 0 to 5 cm depth the soil porosity was decreased by 0.2 % to 5.3 % under 10 mm to 40 mm compost covers.

2) Compost cover increased soil porosity significantly in 5 to 20 cm soil depth. The increment was 2.6 % to 7.0 % for 10 mm to 40 mm compost covers.

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