

# Effects of different land consolidation methods on soil properties of cultivated land

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**Abstract.** As an important reserve cultivated land resource in my country, its development and utilization are of great significance to ensure food security. Aiming at the problems of bare gravel leakage and shallow soil layer in the barren rock beach area, through community simulation experiments, different covering soil structures were set up on the basis of the underlying gravel, and the effects of different covering soil structures on soil physical and chemical properties and crop yield were monitored to obtain Find suitable soil structures. The results show that: when the covering thickness is 60cm, the content of total nitrogen and available phosphorus in the soil reaches the maximum; when the soil bulk density is set to 1.5 g/cm<sup>3</sup>, the content of available phosphorus in the soil reaches the maximum. The content of available potassium increased with the increase of soil bulk density.

**Key words:** Barren rock beach, gravel, Soil physical and chemical properties, Soil bulk density.

## 1. Introduction

Cultivated land is the most precious resource in my country and the lifeblood of ensuring national food security[1-4]. At this stage, my country is facing a shortage of land resources[5,6] and the quality of cultivated land is declining. As an important reserve resource of cultivated land, barren rock beaches can significantly increase the area of cultivated land and have huge social and economic benefits[5,6]. However, in the process of remediation of barren rock beaches, there is the problem of extensive soil covering methods, and there is no basis for the thickness and bulk density of soil covering. How to construct a ploughing layer to meet crop growth is an urgent problem that needs to be solved<sup>[7-9]</sup>. By designing a community simulation experiment, in view of the serious leakage of soil water and nutrients and the unclear suitable soil structure in the land remediation of barren rock beach, different covering soil structures were set up on the basis of the underlying gravel, and the effect of different covering soil structures on the impact of different covering soil structures was monitored. The influence of soil physical and chemical properties and crop yield in order to obtain suitable soil structure.

## 2. Experimental program

### 2.1 Experimental area

The experimental area is located in Ducun Town, Fuping County, Shaanxi Province. The region has a semi-arid continental climate and is located in the transition zone between the Guanzhong Plain and the Northern Shaanxi Plateau. The rainy season is concentrated from July to September, accounting for 50% of the annual rainfall. The seasons are distinct, the spring is windy and less rainy, and the amount of water evaporation is large. The annual evaporation is 950-1290mm, which is 2-2.5 times of the rainfall. The frost-free period is 225 days, and the annual average temperature is 13.5 °C. The climatic conditions meet the growth needs of the main cash crops in the north such as wheat and corn.

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## 2.2 Experimental Design

A total of 12 test plots were designed in this experiment, each with an area of  $2\text{ m} \times 4\text{ m} = 8\text{ m}^2$ . The test plot is divided into two treatment methods, one is treatment with different covering soil dimension, and the other is treatment with different covering soil bulk density. In the treatment of covering soil thickness, the dimension of the overlying soil sheet was 30 cm, 40 cm, 50 cm, 60 cm, 80 cm and 100 cm, respectively. In the control treatment, the bulk density of the whole body is  $1.2\text{ g/cm}^3$ , and the other treatments are divided into upper, middle and lower layers, the upper layer is 20cm, the middle layer is 20cm, and the lower layer is 10cm, and the upper and middle layers are  $1.2\text{ g/cm}^3$  and  $1.3\text{ g/cm}^3$  remain unchanged, and the lower layer is set to  $1.3\text{ g/cm}^3$ ,  $1.4\text{ g/cm}^3$ ,  $1.5\text{ g/cm}^3$ ,  $1.6\text{ g/cm}^3$  and  $1.7\text{ g/cm}^3$  according to the treatment method.

In the experiment, according to the recommended plan for wheat fertilization by the local agricultural department, the N,  $\text{P}_2\text{O}_5$  and  $\text{K}_2\text{O}$  fertilization rates of the experimental fields were  $255\text{ kg/hm}^2$ ,  $180\text{ kg/hm}^2$  and  $90\text{ kg/hm}^2$ , respectively. When sowing winter wheat, enrich according to the plot plan, and make the ground level by manual ploughing and deep loosening, and the fertilizer is fully mixed. All the experimental fields were artificially planted, and the phosphate fertilizer, nitrogen fertilizer, and potassium fertilizer were diammonium phosphate, potassium chloride, urea, etc. respectively. The sowing was artificially planted, and the field management measures during the experiment were the same as those in the local field.

## 2.3 Measurement items and methods

The soil index detection is stratified sampling detection. For soils with different depths and different covering soil thicknesses (covering soil bulk density), the soil mechanical composition is determined by the hydrometer method; the Kjeldahl method is used to determine the total soil nitrogen; the molybdenum antimony resistance colorimetric method is used. Determination of soil available phosphorus; using flame photometry to determine soil available potassium [10].

## 2.4 Data processing

R software was used for statistical analysis of the data, and Origin was used for plotting.

## 3. Results and Analysis

### 3.1 Analysis of soil pH in different treatments

Figure 1a shows the pH values of soils under different cover thickness treatments. It can be found that in the treatment with the covering thickness of 50, the highest reaches 8.4. Figure 1b depicts the pH value of soil under different bulk density treatments, and it can be found that with the increase of soil bulk density, soil pH value is also increasing. It was verified that different soil covering thickness and different soil bulk density have a significant effect on soil pH value.

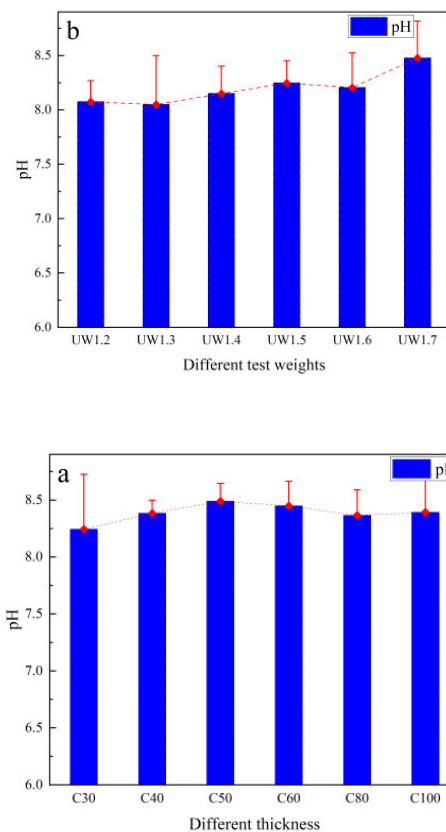
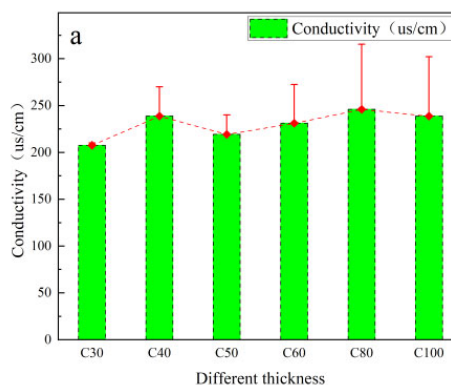
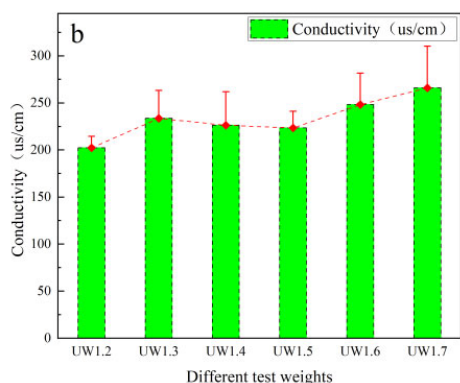


Figure. 1 Differences of soil pH in different treatments

### 3.2 Analysis of soil conductivity with different treatments

By measuring the conductivity of different treatments, the results are shown in Figure 2. For different covering soil thickness treatments, the conductivity of C40 treatment is the largest. For different soil bulk density treatments, the treatment with bulk density of  $1.7\text{ g/cm}^3$  has the highest conductivity, and the treatment with bulk density of  $1.2\text{ g/cm}^3$  has the lowest conductivity.

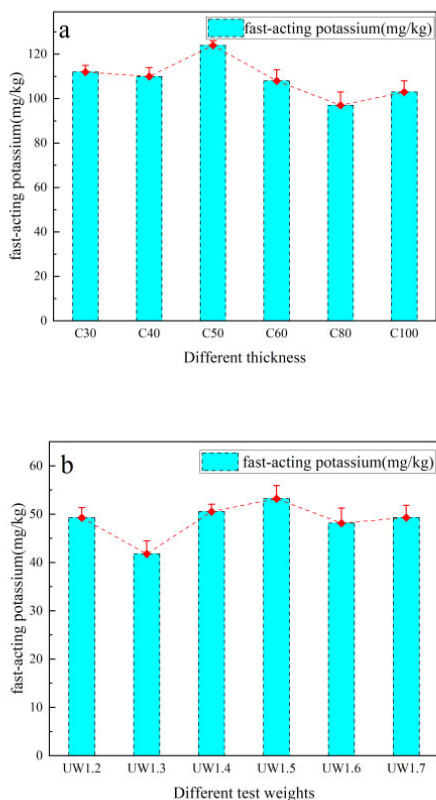




**Figure 2** Differences in soil conductivity of different treatments

### 3.3 Analysis of Soil Available Phosphorus in Different Treatments

By testing the available phosphorus content of different treatments, it can be found that in different soil covering thickness treatments, the available potassium content is C60>C80>C100>C30>C50>C40; in different soil bulk density treatments, the available potassium content is UW1.5>UW1.4>UW1.2>UW1.7>UW1.3. It shows that when the soil cover thickness is 60 cm, the bulk density of the soil tillage layer is set to 1.5 g/cm<sup>3</sup>, which is most conducive to the accumulation of soil available phosphorus.



**Figure 3** Differences of soil available potassium in different treatments

## 4. Conclusion

Different soil covering thickness had no significant effect on soil pH value. In different soil bulk density treatments, soil pH increased slightly with the increase of soil bulk density. When the covering soil thickness is 40cm, the conductivity of the soil is the largest. The treatment with a bulk density of 1.7 g/cm<sup>3</sup> has the highest conductivity, and the treatment with a bulk density of 1.2 g/cm<sup>3</sup> has the lowest conductivity.

The contents of total nitrogen, available phosphorus and available potassium in the soil did not show a simple linear relationship with the increase of the covering soil thickness. When the covering soil thickness was 60 cm, the total nitrogen and available phosphorus contents in the soil reached the highest. When the covering soil thickness was 50cm, the content of available potassium in the soil was the highest. The content of available potassium showed a linear growth trend with the increase of soil bulk density.

The research results of field experiments have confirmed that in the process of covering soil reconstruction of barren rocky beach, it is necessary to realize that it is not that the deeper the covering soil thickness is, the better the growth of crops, but that the covering soil thickness should be set at about 50cm, and the soil bulk density should reach 1.5g./cm<sup>3</sup>, it can be well adapted to the growth of crops. It provides a reference for the reconstruction of barren rock beach soil.

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