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EFFECTS OF DIFFERENT FERTILIZATION TREATMENTS ON SOIL NUTRIENTS OF NEW CULTIVATED LAND

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Abstract

In view of the coarse soil particles, poor fertility, and easily available nutrients the promotion and protection mechanism of soil nutrients in the newly reclaimed cultivated land increased with the application of different rates of organic fertilizers. The experiment was set as per promotion of nutrient, balance management and different states of reconstruction of soil monitoring. By studying the changes of soil organic matters, available phosphorus and potassium and other nutrient indicators, it was found that after three years of "winter wheat summer corn" rotation, the soil nutrients improved to a certain extent in one treatment (0 - 30). The results also showed that the content of soil organic matter increased, but the content of soil organic matters in two other treatments decreased the content of available phosphorus in 0 ~ 1 cm depth of soil changed a little, but it decreased significantly at 15 - 30 cm. The content of available potassium in soil at different treatments and depths showed an increasing trend. The growth rate in one treatment was maximum (107.5 - 155.9 mg/kg), with an increase of 45%. The results also showed that in another treatment (organic fertilizer 450 kg/hm^2) had the maximum effect on soil organic matter, available phosphorus and potassium.

Introduction

The reclaimed mountainous area of arable land is very precious. How to improve the soil fertility quickly and effectively of the newly added arable land was the main problem in land engineering (Li *et al.* 2016, Liu *et al.* 2019). Mountain soil has coarse grains, poor fertility retention, and easy nutrient loss. It is of great significance in deed to explore the improvement and protection mechanism of soil nutrients in different texture types and aggregation states (Gomez-Sagasti *et al.* 2012, Kumar *et al.* 2015).In mountainous soils, there are also loss of nutrient and deficiency problems (Liu *et al.* 2009). Therefore, this study will reveal as to how to improve the soil nutrients of the newly reclaimed cultivated land as the main task. The experiment was set up in view of improvement of soil nutrient, balanced management and different states of reconstruction of soil nutrient monitoring work (Denef *et al.* 2013, O'Neill *et al.* 2005).

The improvement of soil nutrients and the balanced and coordinated supply rely on a variety of technologies. Among them, under the condition of the same nutrient input form, the main thing is to improve the chemical form of soil nutrients (Zhou and Yu 2015). In the newly-reclaimed cultivated land or mountainous soil, the content of organic matter is insufficient. In addition to increasing the input of organic fertilizer, another effective way is to add inorganic fertilizer to the newly-reclaimed cultivated land to promote the rapid construction of the soil biological system and increase the accumulation of organic matter (An *et al.* 2011). Under the social background where the quantity of organic fertilizers is limited, it is necessary to use the "inorganic matter for organic matter growth", which has become an option that must be persisted and tried in the future

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of land engineering (Mcintosh *et al.*1996, Ge *et al.* 2007). Set up of a nutrient management test plot is required to explore the effect of using different fertilizers on the conditions of soil nutrient (Wang *et al.* 2012, Pellegrino and Bedini 2014). An attempt was made to set up organic fertilizer while designing the main experiment to study the influence of different rates of application of organic fertilizer on soil quality to screen the optimum amount and achieve the measure soil nutrition protection.

Materials and Methods

The pilot plot was established in Meixian County, Baoji city, in the west of the Guanzhong plain in Shaanxi province, with the Qinling mountains in the south and Weishui in the north. Geographical coordinates are between 107°39′~108°00′ east longitude and 33°59′~34°19′ north latitude, and the altitude is between 442 and 3767 m. It is a warm, temperate continental semi-humid climate with an average annual temperature of 12.9°C. The average precipitation is 609.5 mm, the average sunshine is 2015.2 hrs, and the frost-free period is 21 days. Each year from March to May, the warming is faster, and the Autumn is affected by the cold air, and the difference of temperature between day and night is more obvious. It is one of the areas with the most Autumn rain in Guanzhong. The topography of this area is complex, and it is generally an asymmetrical topography with high north-south and low-middle. The county can be divided into five types of land forms: Qinling Mountains (over 700 m above sea level), Loess Plateau, Piedmont Alluvial Plain, Weihe Alluvial Plain, and Weibei Loess Plateau (Evans *et al.* 2013).

There are six test plots in total, each of them covers an area of 6 m × 5.5 m = 33 m^2, a total area of 198 m^2. The test field had to be backfield with extra soil to ensure that it was plane and elevated. It was divided as per design, organic fertilizer was applied according to the fertility of the test design, artificially plant and divide the ridge (Kong *et al.* 2006).

The experiment adopts a random block design with three treatments. Treatments 1, 2 and 3 were with added organic fertilizers 300, 375 and 450 kg/hm^2, respectively. Organic fertilizer was applied at one time. According to the recommended scheme of fertilization for farmland in Weibei Dryland by the Department of Agriculture of Shaanxi Province, fertilization adopts artificial positioning fertilization method, and the basic fertility is N = 150 kg/hm^2 (N 46%), P_2O_5 = 120 kg/hm^2 (N 18%, P_2O_5 45%) and K_2O = 90 kg/hm^2 (K^2O 50%); nitrogen fertilizer 1/2 is used as base fertilizer, and 1/2 is used as top dressing. Fertilizers were applied at one time (Zhang *et al.* 2014).

A corn-wheat rotation planting system was implemented. Corn was planted in mid-June and harvested at the end of September; wheat was planted in early October and harvested in early June the following year (Urano *et al.* 2008). Three sampling sites were randomly selected in each plot for the service soil samples, and soil samples of 0 - 15, 15 - 30 and 30 - 45 cm soil layers were taken at each sample site. After natural air drying and grinding, the thickness was 0.2, 0.1 and 0.149 mm (Weidenhamer *et al.* 2010).

An additional work was carried out with laboratory analyzed soil samples collected from experimental field. Total nitrogen, extractable phosphorus and exchangeable potassium amounts were determined by Agricultural Engineering Department of Ege University according to the Kjeldahl method, Bingham method and ammonium acetate method.

Results and Discussion

Comparison of organic matter content at soil depths of 0 - 15 and 15 - 30 cm under three different treatments is presented in Fig. 1. It can be seen that the organic matter content of the surface soil (0 - 15 cm) of treatment 1 and treatment 3 shows an increase trend. In treatment 1 after three years of crop cultivation, the soil organic matter at different depths increased, the content of 0 - 15 cm increased from 7.52 to 9.46 g/kg, an increase of 25.7%; the organic matter content of 15 - 30 cm increased from 8.85 the g/kg increase was 10.37 g/kg, an increase of 17.2%. In treatment 2 after three years of testing, the soil organic matter was reduced, the content of 0 ~ 15 cm decreased from 10.38 to 9.17 g/kg, a decrease of 11.7%; the soil organic matter content of 15 ~ 30 cm decreased from 10.25 g/kg. It was 10.11 g/kg, a decrease of 1.0%. After three years of crop cultivation, the soil organic matter at different depths of treatment 3 increased, the content of 0 ~ 15 cm increased from 9.21 to 10.49 g/kg, an increase of 13.9%; the soil organic matter content of 15 ~ 30 cm increased from 8.64 g/kg increased to 10.24 g/kg, an increase of 18.5%.

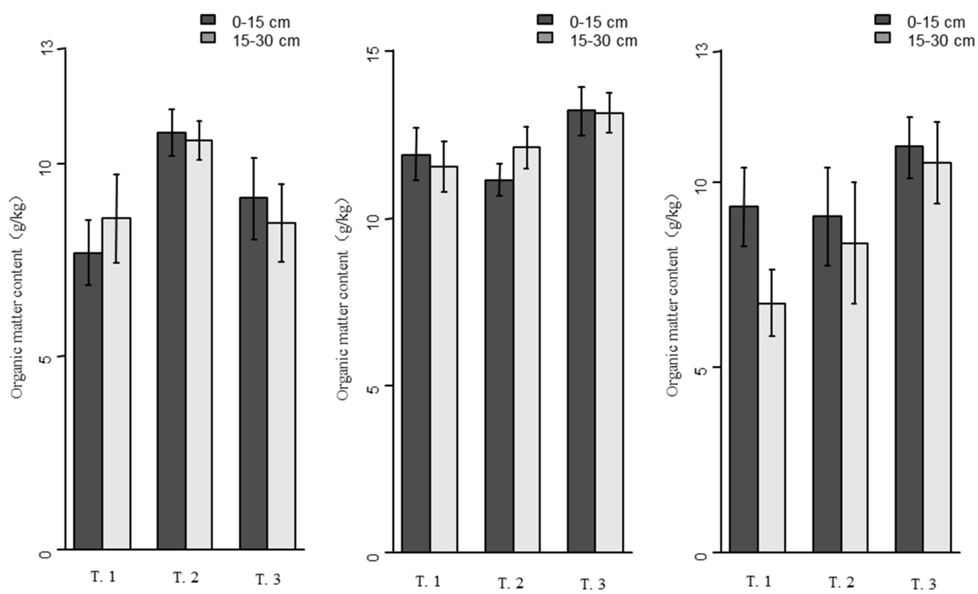

Fig. 1. Changes of content of soil organic matter in different treatments during 2017 - 2019.

It can be seen from Fig. 2 that the available phosphorus content of the soil depths of 0 - 15 cm in 1 and 3 has little change after three years of cultivation. But in 2 after three years of cultivation of crop, the available phosphorus content decreased gradually from 16.7 - 13.8 mg/kg, a decrease of 5.9%. The soil available phosphorus content with depth of 15 - 30 cm showed a decreasing trend, 1 from 17.1 to 8.9 mg/kg, the maximum decrease was 16.6%; 2 from 16.8 - 9.3 mg/kg; 3 from 17.8. The mg/kg dropped to 11.4 mg/kg. In the experimental plots under different treatments, as the soil depth increases, the available phosphorus content gradually decreases. The available phosphorus content of 0 -15 cm soil is significantly higher than 15 cm. This might be because less rainfall is experienced after fertilization, and less leaching effect leads to more phosphorus fertilizer storage in the upper layer.

Fig. 3 shows the comparison of the changes of available potassium content at soil depths of 0 - 15 and 15 - 30 cm in three treatments. The soil available potassium content of different treatments and different depths revealed an overall increasing trend. Treatment 2 had the maximum increase 107.5 to 155.9 mg/kg, an increase of 45%. The content of available potassium at different depths in each plot increased with the depth and decreasing trend.

Soil organic matters, available phosphorus and potassium contents are important indicators that reflect soil fertility and are also important soil nutrients necessary for better crop growth. By studying the changes in soil organic matter, available phosphorus, available potassium, and other nutrient indicators, it was found that the experimental fields applied with organic fertilizer had a certain effect on the improvement of soil nutrients after three years of "winter wheat-summer corn" rotation. It can increase the content of the soil organic matter at the 0 - 30 cm tillage layer, whereas the contents of the organic matter in soil of treatments 1 and 2 were reduced. Different

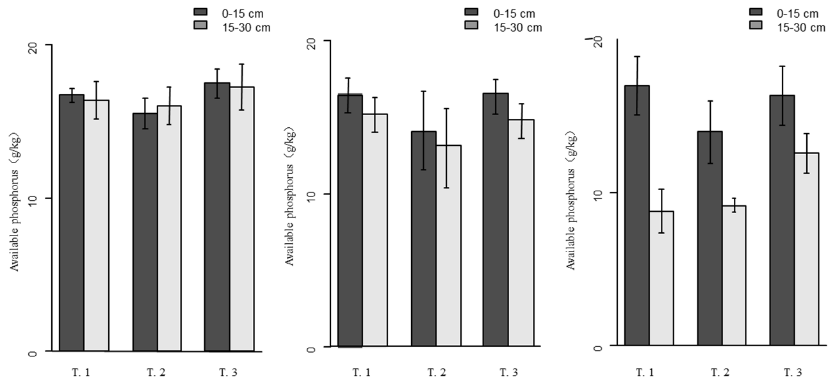

Fig. 2. Changes in content of available phosphorus in soil in different treatments during 2017 - 2019.

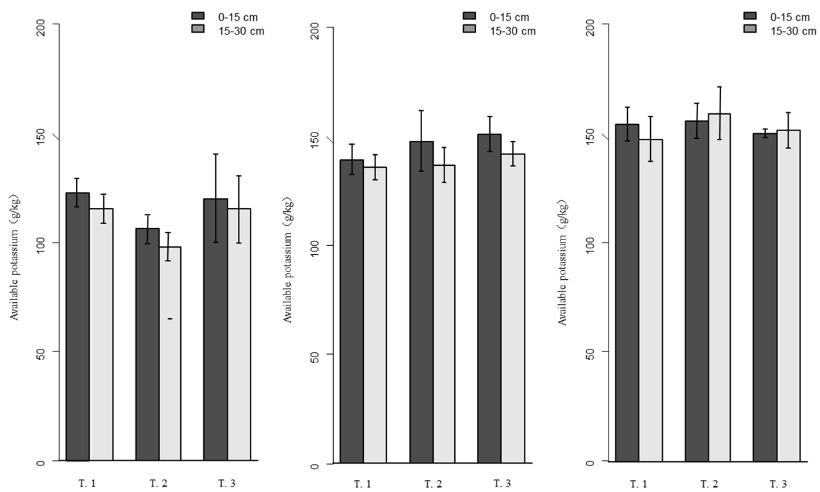

Fig.3. Changes of content of available potassium soil in different treatments during 2017-2019.

treatments at 0 - 15 cm depth of soil changed the content of available phosphorus a little, as against the depth of 15 - 30 cm. The content decreased significantly, and treatment 3 showed the minimum decrease. The content of available potassium in soil of different treatments and at different depths showed an overall increasing trend. Treatment 2 showed maximum increase 107.5 - 155.9 mg/kg, an increase of 45%. In the light of the above observations the changes in the content of organic matter, available phosphorus and potassium in soil with the application rate of 450 kg/hm^2 of organic fertilizer was found to be the best in this experiment.

The study was conducted on the effects of different rate of treatments with fertilizers on the soil nutrients of the newly reclaimed cultivated land in the Qinling mountains. In the follow-up, a comprehensive analysis will be carried out in combination with other physical, chemical and biological properties to explore the possibility of any suitable composition and doses of fertilizers towards increasing the soil nutrients in the newly reclaimed cultivated land in Qinling mountains.

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