Effect of Fertilization on the Maturation of Red Soil Parent Material

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Abstract. Red soil is widely distributed in China, with strong acidity and low nutrient content. It needs to be fertilized and improved when planting crops. The effects of Fertilization on the parent material, phosphorus and sulfur elements in red soil were discussed. Six groups of control experiments were set up, in which different fertilizer combinations were used as the base fertilizer of red soil. The organic matter, phosphorus, pH value and crop growth in red soil were observed by planting wheat and corn. The results showed that the mixed application of chemical fertilizer and organic fertilizer could maintain the fertility of red soil and acid and alkali. The control effect of degree is the best. Therefore, in the process of red soil improvement, we should pay attention to the application of organic fertilizer.

Keywords: land resources, red soil, fertilization, parent material maturation.

1. Introduction
Cultivated land is the material basis for human survival and development. To ensure its quantity and quality is not only the need of economic development, but also an important guarantee for social stability and national security \cite{1}. At present, the demand for all kinds of non-agricultural land is greatly increased, and the cultivated land is sharply reduced, which seriously restricts the sustainable development of agriculture \cite{2,3}. Although more and more efforts have been made to develop new and reclaimed cultivated land in different regions, due to the lack of mature soil cultivation layer, poor nutrient and low crop yield, it is imperative to mature cultivated land \cite{4}. Soil ripening of cultivated land refers to the process of continuous improvement of soil till ability, continuous improvement of soil fertility and transformation of raw soil into mature soil through technical measures such as soil improvement and fertility improvement. Theoretical analysis shows that different ripening processes, different types of fertilization and fertilization methods have a great impact on the changes of nutrients such as nitrogen, phosphorus, potassium, calcium, magnesium and other elements in the soil, as well as on the impact of microorganisms in the soil. The analysis of different ways and methods of fertilization...
plays an important role in the analysis and evaluation of soil nutrients, physical chemistry and microorganism, as well as the impact on crop planting [5].

Red soil is an important agricultural soil in South China. According to the statistics of 12 provinces, red soil cultivated land accounts for 36% of cultivated land area. Generally, there are many metal compounds with four and six coordination in red soil, including iron compounds and aluminum compounds. The iron compounds in red soil often include limonite and hematite, etc. There are more hematite in red soil, which is the product of interaction between biological enrichment and desilication, iron enrichment and Aluminization. In China, the red soil area is the main production area of rice, tea, silk and sugarcane, and the mountain area is also suitable for planting economic trees such as fir, tung oil, citrus, moso bamboo and palm (Fig. 1) [6]. The red soil is strong in acidity and heavy in clay, which is a disadvantageous factor in the utilization of red soil. The fertility of red soil can be improved by applying more organic fertilizer, appropriate amount of lime and supplementary phosphate fertilizer, and preventing soil erosion [7].

The improvement measures of red soil include afforestation, land leveling, mixing sand with soil, strengthening water conservancy construction, increasing the content of organic matter in red soil, scientific fertilization, lime application, and reasonable planting system [8]. Since the establishment of the British Rothamsted station in 1843 and the first study of long-term fertilizer positioning, many countries have carried out long-term fertilizer experiments and achieved positive results [9]. In the red soil hilly area with superior hydrothermal conditions, people pay more and more attention to all kinds of wasteland resources. However, in order to develop these soil resources, we must start from the ripening of raw soil. In order to comprehensively and systematically study the rather complex process of soil ripening and seek suitable ripening methods, the red soil Station of the Chinese Academy of Agricultural Sciences, as early as 1982, arranged long-term ripening experiments of different raw soils in the same bioclimatic conditions and the same topographical position in guanshaping, Qiyang, Hunan Province. After ripening, the physical and chemical properties of the soil [10], soil nutrients and related chemical properties [11], and the components of soil phosphorus [12] have changed to some extent. In this paper, the effects of fertilization process on the parent material of red soil, the adsorption and desorption of soil phosphorus components, the transformation and effectiveness of organic and inorganic sulfur in the soil were analyzed, so as to provide reference for the improvement and research of red soil.

2. Effect of fertilization on phosphorus and sulfur

2.1. Effect of fertilization on red soil parent material
In general, regular application of chemical fertilizer and organic fertilizer can effectively improve soil fertility, and mailing fee can increase the carbon content of microbial population in the soil. For red soil, the decomposition rate of organic matter is faster. If the amount of organic fertilizer is not increased in the process of fertilization, the content of organic matter in the soil will decrease rapidly and the overall fertility of the soil will be reduced. The investigation in the red soil dry land shows that due to the
influence of nature and traffic, the extensive management of dry land does not pay enough attention to the application of organic fertilizer, resulting in the low content of soil organic matter.

Acid soil is one of the factors that restrict the growth of crops, while red soil is generally acidic. Therefore, improving the soil by fertilization can improve the pH value of the soil and maintain the stability of the soil pH, which is also an important basis for evaluating the rationality of fertilization in red soil. The long-term application of chemical nitrogen fertilizer will lead to the increase of soil acidity. Therefore, it is necessary to use organic fertilizer and chemical fertilizer to create better soil parent material conditions for the growth of crops.

2.2. Effect of fertilization on phosphorus
In fact, the utilization of P fertilizer applied to the soil by crops is relatively low, generally 10% - 20%. Most of the P fertilizers are in the form of organic P and inorganic P, while most of the P in the soil is widely distributed in the form of inorganic P. Previous studies have shown that long-term application cost or organic fertilizer can increase the content of phosphorus in the soil, a large number of microorganisms in the soil can also absorb fertilizer phosphorus to further improve the content of organic phosphorus, and the effect of phosphorus fertilizer is obvious, which can improve the red soil more effectively.

2.3. Effect of fertilization on sulfur element
Generally, there are two states of sulfur element in cultivated land: organic sulfur and inorganic sulfur. During the growth of crops, inorganic sulfur can only be effectively absorbed. Therefore, organic sulfur needs to be converted into inorganic sulfur to become fertility, while organic sulfur accounts for more than 85% in cultivated land. As a result, the source of available sulfur in soil is more dependent on the content of organic sulfur. Organic sulfur in soil is mainly affected by the content of organic matter in soil, the activity of microorganism in soil and the natural environment.

3. Test materials and methods

3.1. Soil index
The soil comes from Quaternary red soil, and the original property test results are shown in Table 1 below.

| Items      | Organic matter [g/kg] | N [g/kg] | P [g/kg] | K [g/kg] | pH      |
|------------|-----------------------|----------|----------|----------|---------|
| Value      | 12.3                  | 0.92     | 1.01     | 11.6     | 5.5     |

3.2. Test scheme
The soil comes from Quaternary red soil, and the original property test results are shown in Table 1 below. In order to compare the effects of different fertilization schemes on the fertility of red soil, 6 groups of control experiments were set up for analysis.

(a) Group A was used as control analysis group without any fertilizer.
(b) Group B: phosphate fertilizer.
(c) Group C: phosphate and nitrogenous fertilizer.
(d) Group D: phosphate, Nitrogenous and potash fertilizer.
(e) Group E: phosphate, Nitrogenous, potash and organic fertilizer.
(f) Group E: organic fertilizer.
The brand, type and quality of each fertilizer are consistent. Wheat and corn are cultivated in red soil, and fertilizer is used as base fertilizer, which is pre cultivated in red soil.

3.3. Fertilization amount and management
The annual application amount of each fertilizer is 250kg/hm$^2$ of nitrogen, 100kg/hm$^2$ of nitrogen and 100kg/hm$^2$ of potassium, with the proportion of 1:0.4:0.4. Organic fertilizer was used to transport pig manure in pig farm. All the experimental groups were used as basal fertilizer before sowing wheat and corn.

The management requirements of each group are the same when weeding and controlling crop diseases and insect pests in the planting process.

3.4. Determination content and method
Before harvest, samples were taken from different groups in the experimental soil area, soil layers of 5-20cm were collected, the soil samples were dried, ground and stored in bags.

Potassium dichromate volumetric method, Kjeldahl method for total nitrogen, alkali fusion molybdenum antimony colorimetric method for total phosphorus, NaOH fusion flame photometric method for total potassium, and other analytical methods are shown in soil physical and chemical analysis standard [13].

4. Results and analysis
4.1. Influence of organic matter content
The content of soil organic matter is closely related to the soil fertility, but at present, some scholars have proposed that when the soil fertility reaches a certain degree, or the content of organic matter in the soil exceeds a certain limit, the organic matter will increase again, and the soil fertility will not continue to improve. Through the analysis and evaluation of the stability of soil organic matter oxides (stability coefficient s), the change of the content of organic matter in the soil is reflected to analyze the soil fertility. See Table 2 for the test results.

| Test group | Organic matter % | S   | Test group | Organic matter % | S   |
|------------|------------------|-----|------------|------------------|-----|
| A          | 1.21             | 0.62| D          | 1.95             | 0.58|
| B          | 1.65             | 0.42| E          | 2.23             | 0.52|
| C          | 1.72             | 0.51| F          | 2.21             | 0.47|

4.2. Effect of available phosphorus
According to the physiognomy characteristics of the restored land, the abandoned land in the mine is constructed into a regional agricultural industrial park, which can make rational and scientific use of the land according to different production objectives, and improve the protection of the ecosystem, so as to make the planning and layout of the land more reasonable.

Phosphorus content in red soil is one of the main factors that restrict soil fertility. The test results are expressed by Olsen-P strength index, as shown in Table 3.

| Test group | Olsen-P | Test group | Olsen-P | Test group | Olsen-P |
|------------|---------|------------|---------|------------|---------|
| A          | 3.1     | C          | 41.6    | E          | 121.4   |
| B          | 4.9     | D          | 32.6    | F          | 81.3    |

4.3. Soil pH effect
The test results of the effect of pH on soil fertility are shown in Table 4.
Table 4. Change of pH value in different groups of red soil.

| Test group | pH  | Test group | pH  | Test group | pH  |
|------------|-----|------------|-----|------------|-----|
| A          | 5.5 | C          | 4.5 | E          | 6.1 |
| B          | 4.3 | D          | 4.4 | F          | 6.3 |

4.4. Crop growth
According to the measurement of plant height of corn, group a almost reached the edge of weak seedling and no yield, and the measurement results are shown in Table 5. Among them, group E had a good growth and the highest yield.

Table 5. Plant height of maize cultivated in different groups of red soil.

| Test group | Plant height cm | Test group | Plant height cm | Test group | Plant height cm |
|------------|-----------------|------------|-----------------|------------|-----------------|
| A          | 61.2            | C          | 95.7            | E          | 161.8           |
| B          | 68.5            | D          | 125.3           | F          | 150.4           |

5. Summary
A. The results showed that the mixed application of chemical fertilizer and organic fertilizer is an important measure to increase soil organic matter. The application of organic fertilizer can keep pH value of red soil and prevent soil acidification.

B. In the actual natural environment, due to the influence of rainwater, the conservation and loss of fertility are also factors to be considered.

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