The Effect of Different Soil Body Configuration on Growth and Development of Summer Maize in Guanzhong Region, Shaanxi Province

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Abstract. The soil body configuration is the most important link in the process of agricultural land remediation. It has a serious impact on the fertility of the rehabilitated land and the economic investment in remediation. Six experimental plots with different tillage layer thickness and transitional layer were constructed manually. After the completion of the plots, the common crop maize in Guanzhong area was planted, and the plant height, chlorophyll, spike diameter and spike length were measured, the yield was calculated, the growth status of maize in different plots were compared. The results showed that the yield of maize was the highest in the plot that the thickness of tillage layer was 60 cm and used Loamy loess as transition layer, which was the most suitable soil body configuration for the growth of maize in Guanzhong area.

1. Introduction

Soil body configuration is also called the soil profile structure. It is the most important feature of soil profile. It refers to the regular combination and orderly arrangement of soil layers with different textures, and is Physical heterogeneity in soil profile formed by human and natural factors [1]. As the basis for agricultural production, soil structure seriously affect the soil moisture, fertility, the use of storage and other processes, and thus affecting the level of agricultural land and crop yield [2]. In recent years, with the people's attention to the environment and ecology, soil structure has become a hot issue for scholars both at home and abroad [3-5].

Land remediation is one of the main aspects of artificially forming soil body configuration. It is a general term for land consolidation, reclamation and repeat reclamation. It mainly takes the integrated control of land through engineering measures to improve the land use efficiency and output efficiency [6-8]. Therefore, in the process of land reclamation of agricultural land, in order to ensure the maximum economic benefits, we must seek the best proportion of soil cover by studying the crop yield of land with different soil structure. In this paper, by observing the growth of summer maize in Guanzhong region under different compounding ways, the best compounding way in the process of
agricultural land remediation was obtained, which provided the data support for land remediation and field construction in the future.

2. Methods

2.1. Research Area
The research area was located in the northern foot of Qinling Mountain, located in the west of the Guanzhong Plain, at 107°39′–108°00′ east longitude and 33°59′–34°19′ north latitude, Mei County, Shanxi, China. It belongs to the Chuanyuan Gully Area in the middle reaches of the Yellow River. Meixian is a warm temperate continental semi-humid climate, with an altitude of 442-3767m, an annual average temperature of 12.9℃ and an average rainfall of 609.5mm, an average of 2015.2 hours of sunshine and an frost-free period of 21 days. From March to May of each year, the warming was quicker, the autumn was affected by the cold air, and the temperature difference between day and night was more obvious. It was one of the areas with the most autumn rains in the Guanzhong area.

The highest point of the county is the second peak of Taibai Mountain, with an elevation of 3771.2m; the lowest point is located at the east outflow of Weihe River at the junction of Qinghua County and Fufeng County, with an elevation of 442m. In accordance with the landform features, the county can be divided into Qinling Mountains, loess Liangyuan, piedmont alluvial plain, Weihe alluvial plain, Weibei Loess Plateau, five types of landforms. In a word, the county presents the topography of “seven rivers and nine plain slopes, six mountains and three water fields”.

2.2. Experimental Design
The experimental plot was completed in March 2017 and is divided into six subdivisions with the same area of each plot of about 3m×2.8m = 8.4m². Each plot was divided into three layers: Tillage layer, transitional layer and bottom layer. Tillage layer was made up of local loess, including the casing thickness of 40cm and 60cm two types. The transitional layer consisted of three different treatments, using fine sand, loess and clay as the transitional layers for each treatment. At the bottom of the six plots, the same treatment was carried out, firstly, filled the blocks with the same diameter, and then filled the gaps between the blocks with small gravel, and the gravel layer at the bottom strictly controlled the block size. The soil structure of each plot was shown in Table 1.

| Number | Clay type | Cover soil thickness(cm) | Transitional layer | The bottom |
|--------|-----------|--------------------------|------------------|-----------|
| Plot1  | Loamy loess | 40                       | Fine sand        | Filling with stones of equivalent diameter, used |
| Plot2  | Loamy loess | 60                       | Fine sand        |          |
| Plot3  | Loamy loess | 40                       | Loamy loess      |          |
| Plot4  | Loamy loess | 60                       | Loamy loess      | small gravel to fill |
| Plot5  | Loamy loess | 40                       | clay             | the gaps between |
| Plot6  | Loamy loess | 60                       | clay             | stones.   |

After the completion of the experimental field, the drip irrigation system was installed. In April 2017, we selected Hudan 4, the most common maize crop in the Guanzhong area, as a research crop, with 6 lines per plot and 18-20 lines per line. The organic fertilizer was mixed well and applied by artificial. After the maize sprouted, we went to weeding and irrigation regularly, and controlled the irrigation volume to make sure the six plot under the same management conditions.

After the maize sprouted, various indexes were determined successively, including plant height, chlorophyll, spike diameter and spike length. The data of each plot were obtained by determining the indexes of 5 plants randomly and averaging them. The yield of maize was measured after maturation in September. Figure 1 showed some of the major experimental process.
3. Results and Analysis

3.1. The Plant Height

The plant height was measured from May onwards when the maize came out and ended at July when it stopped growing (Figure 2). Overall, the plant height of the maize in the plot was changed significantly over time. The differences of plant height between the six plots in May were not significant. However after entering in June, there was a clear difference in the plant height among the plots, it could be seen that the plant height of plot 1, plot 2 and plot 3 was significantly higher than that of plots 4, plot 5 and plot 6. At the same time, it could be seen that the growing trend of plot 5 and plot 6 has slowed down.
significantly since June. The highest plant height was plot 2, followed by plot 1 and plot 3, while plot 5 and plot 6 had the lowest plant height, which indicated that the plant height of the plots with tillage layers of 40cm and 60cm had not changed much, while the different of transition layers had greater impact on plant height.

3.2. Relative Chlorophyll Content
The relative chlorophyll content of maize leaves was determined using the portable chlorophyll meter (ccm-200) (Figure 3). It could be seen that the relative chlorophyll content of maize leaves in the six experimental plots all showed the tendency of increasing first and then decreasing gradually. Comparing six different experimental plots, we can see that the relative chlorophyll content of maize leaves in different periods was not very different. However, by comparing the total relative chlorophyll averages in different experimental plots, it was found that the relative chlorophyll content of plot 4 was the highest, followed by plot 2 and plot 6 in row 3. From the average chlorophyll content, we may reached a conclusion that the growth state of the maize in plot 4 was the best, which may indicated that the plots 2, 4, and 6 with the tillage layer thickness of 60cm were more conducive to the growth of maize leaves.

![Figure 3. The variation of relative chlorophyll content.](image)

3.3. Spike Length and Spike Diameter of Maize

![Fig 4. The variation of spike length.](image)
Spike length data for maize was measured from July. Comparing the average length of ear of maize in six plots, it was found that the ear length of plot 3 and plot 4 were the longest, plot 6 was the shortest (Figure 4).

![Figure 5. The variation of spike diameter.](image)

The spike diameter of maize was also measured from July. It increased with time obviously in July, while hardly changed with the increase of time until the end of July. Comparing the average of the ear diameter of the six plots, it could be seen that the average of the ear diameter of plot 2, plot 3, and plot 4 were very close, and the average of the ear diameter of plot 6 was the shortest (Figure 5).

Comparing maize ear length and ear diameter, it could be seen that ear diameter and ear length of plot 2, plot 3, and plot 4 were the largest, which may indicated that the transitional layer consisted of loamy loess was most conducive to the growth of maize.

3.4. Yield Parameters of Maize

The maize was harvested in September, and the samples of different experimental plots were collected during the harvest. The outermost two rows of each plot was removed to eliminate the influence from border effect, and the remaining twelve plants in the middle were collected as samples, and then take five samples by size to measure spike diameter, spike length, line grain number, ear row number, thousand grain weight and yield. The specific parameters in Table 2, the yield of maize in Table 3. It could be seen that among the six plots, the highest output was plot 4, secondly plot 2, plot 6 was the third, and plot 1 was the lowest. Except the plot 1 and plot 3, the yield of summer maize in rest plots were higher than average yield in Baoji City [9].
Table 2. The yield parameters of maize.

| Number | Thousand grain weight(g) | Spike diameter(cm) | Ear rows | Line grain number |
|--------|--------------------------|--------------------|----------|------------------|
|        |                          |                    |          |                  |
| Plot1  | 216.6                    | 4                  | 14       | 48               |
|        |                          | 4.6                | 16       | 39               |
|        |                          | 4.1                | 14       | 47               |
|        |                          | 4                  | 16       | 24               |
|        |                          | 3.9                | 14       | 34               |
|        |                          | 4.4                | 14       | 44               |
|        |                          | 4.2                | 14       | 40               |
| Plot2  | 254.88                   | 4.1                | 14       | 44               |
|        |                          | 4.5                | 16       | 44               |
|        |                          | 4.3                | 14       | 50               |
|        |                          | 3.75               | 14       | 26               |
|        |                          | 3.9                | 14       | 37               |
| Plot3  | 232.77                   | 4.4                | 14       | 45               |
|        |                          | 4.2                | 16       | 45               |
|        |                          | 4.1                | 14       | 42               |
|        |                          | 4.2                | 12       | 50               |
|        |                          | 4.2                | 14       | 43               |
| Plot4  | 274.75                   | 4.4                | 14       | 46               |
|        |                          | 4.25               | 14       | 44               |
|        |                          | 4.1                | 14       | 45               |
|        |                          | 3.7                | 12       | 45               |
|        |                          | 3.9                | 14       | 38               |
| Plot5  | 239.09                   | 4.2                | 14       | 46               |
|        |                          | 4.65               | 16       | 45               |
|        |                          | 4.5                | 16       | 46               |
|        |                          | 3.3                | 12       | 46               |
|        |                          | 4.25               | 14       | 45               |
| Plot6  | 252.41                   | 4.3                | 16       | 40               |
|        |                          | 4.3                | 14       | 47               |
|        |                          | 4.2                | 14       | 44               |

Table 3. The maize yield in different plots (kg/hm²).

| Number | Plto1    | Plto2   | Plto3   | Plto4    | Plto5    | Plto6   |
|--------|----------|---------|---------|----------|----------|---------|
|        | 7678.65  | 9730.05 | 8277.15 | 10526.7  | 8931     | 9122.1  |

4. Conclusion
From the plant height, chlorophyll, spike diameter, spike length, and yield, we may get a conclusion that the compounding method of plot 4 was the best and most suitable for the growth of summer maize in Guanzhong area. By comparing the tillage layers with 40cm and 60cm soil cover, it was concluded that the thickness of 60cm was more suitable for the growth of maize. In the case of the same thickness of the upper soil cover, loess and clay were better than the fine sand as the transitional layer. However, in the process of land remediation, the cost of loess and clay were relatively high, therefore, considering economic factors, as long as the thickness of tillage layer was enough to meet the normal growth of crops, filled with some fine sand in transition layer may maximize the economic benefits.
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