Differences in properties of long-term planting of different formulated soils

Yangjie Lu¹,²,³,⁴*, Zhen Guo¹,²,³,⁴, Yike Wang¹,²,³,⁴, Tingting Cao¹,²,³,⁴

¹Institute of Land Engineering and Technology, Shaanxi Provincial Land Engineering Construction Group Co., Ltd. 710075, Xi’an, China
²Shaanxi Provincial Land Engineering Construction Group Co., Ltd. 710075, Xi’an, China
³Key Laboratory of Degraded and Unused Land Consolidation Engineering, the Ministry of Natural Resources, 710075, Xi’an, China
⁴Shaanxi Provincial Land Consolidation Engineering Technology Research Center.710075, Xi’an, China

*Corresponding author e-mail: 995915203@qq.com

Abstract. The characteristics of soil organic carbon, polysaccharides and calcium carbonate content in different proportions of compound soil were studied in the compound soil of arsenic rock zone and sand with rotation for 2 years, and the ripening of the mixed soil of arsenic rock zone and sand in different proportions was revealed. The results showed that the ratio of easily oxidized organic carbon in the 1:2 ratio of arsenic rock zone to sand is the highest in total organic carbon, the activity of organic carbon is the highest. And the content of polysaccharides and calcium carbonate in soil is higher, the water-soluble aggregates in soil were better developed.

1. Preface
Arsenic rock zone and sand, two types of land that are difficult to use, can form new soil after compounding [1-3], but the difference in soil maturity degree after different proportions of compounded soil after rotation is not specifically studied. The indicators for assessing the degree of soil maturity include soil fertility, soil organic carbon and agglomerate stability. Among them, soil organic carbon is an important indicator for evaluating soil quality, which determines the level of soil fertility [4-7]. Soil active organic carbon can be characterized by water-soluble organic carbon, microbial organic carbon and easily oxidized organic carbon [8-9]. It is important to study soil organic carbon and activated carbon content and distribution to reveal soil development.

In this study, the changes of soil organic carbon, polysaccharide and calcium carbonate content and distribution in different proportions of compound soil of arsenic rock zone and sand compound soil were studied. It was concluded that the soil maturity degree of different proportions of compounded soil after rotation was planted.
2. Materials and methods

2.1. Materials
Arsenic rock zone and sand for the test were taken from Dajihan Village, Xiaojihan Township, Yuyang District, Yulin. Its physical properties are shown in Table 1.

Table 1. Original soil physical properties

| Particle size ratio | Arsenic rock zone | Sand |
|---------------------|------------------|------|
| Sand particles (0.05–2mm) | 34.82 | 96.33 |
| Silt (0.002–0.05mm) | 58.19 | 1.44 |
| Clay (<0.002mm) | 6.99 | 0.23 |

| Soil texture (USDA) | Capillary porosity (%) |
|---------------------|------------------------|
| Silt loam soil | 45.26 |
| Sand | 24.97 |

2.2. Method

Overview of the test area. The experiment was carried out at the Fuping pilot test base of the Shaanxi Institute of Geotechnical Engineering. Fuping County (108°57'-109°26'E, 34°42'-35°06'N) is the transition zone between the Guanzhong Plain and the Northern Shaanxi Plateau. It belongs to the gully region of the Loess Plateau in northern Hebei. The terrain is high in the north and low in the south. It slopes from northwest to southeast. The elevation is 375.8-1420.7 m. It belongs to the continental monsoon warm zone with semi-arid climate. The annual total radiation is 5187.4 MJ/m², and the annual average sunshine. The hour is about 2389.6 h, the annual average temperature is 13.1°C, and the annual average precipitation is 527.2 mm. The interannual variation of precipitation is large, and the annual precipitation coefficient of variation (CV) is 21.1%.

2.2.1. Test design. In the experiment, the mixing ratios of arsenic rock zone and sand with different planting years were set to 0:1, 1:1, 1:2 and 1:5, respectively, and 4 ratios were set for each mixing ratio, for a total of 24 plots. The area of each cell is 2m×2m. In the surface layer of each plot, 30 cm is covered with compound soil of different mixing proportions, and below 30 cm is the local original sand. The experimental field was corn (Jincheng 508)-wheat (Xiaoyan 22), which was made by two crops a year, all of which were artificially sown. The types of fertilizers tested in the experimental field were urea, ammonium phosphate and potassium chloride. The amount of fertilizer applied was N-P₂O₅-K₂O (255-180-90 kg/hm²) per year.

2.2.2. Test indicators and data processing. Total organic carbon in soil (SOC): determined by elemental analyzer (Multi N/C OR 3100); Soil water-soluble organic carbon (DOC): determined by elemental analyzer (Multi N/C OR 3100); the soil easily oxidized carbon (ROC) is determined by potassium permanganate oxidation-colorimetry.

The test data was analyzed using software such as Excel.

3. Results and analysis

As shown in Fig. 1, after the two-year rotation of the compounded soil, the total organic carbon content of the soil in the sand soil is higher than that of the other compound soils in different soil layers, which may be due to the low soil organic carbon content of the arsenic rock zone in the compound soil material. The soil organic carbon content in the compound soil is lower than that in the sand. The total organic carbon content of the soil in the sandy soil is slightly different between 0-10cm soil layer and 10-20cm soil layer, both of which are larger than 20-30cm soil layer, and the total organic carbon content of 0-10cm soil layer and 10-20cm soil layer is 20-30cm. The soil layer is 30.54% higher and 33.00% higher, respectively. In the compound soil with 1:1 ratio of arsenic rock zone to sand, the total organic carbon content of soil increased first and then increased with the increase of soil depth. The total organic carbon
content was the largest in 0-10 cm soil layer, which was 2.23 g/kg, 53.79% and 27.43% higher than the 10-20 cm and 20-30 cm soil layers, respectively. In the compound soil with the ratio of arsenic rock zone to sand 1:2, the total organic carbon content of the soil also decreased first and then increased with the increase of soil depth. The total organic carbon content was the largest in the 0-10 cm soil layer, which was 2.04 g/kg, 13.33% and 7.37% higher than the 10-20 cm and 20-30 cm soil layers, respectively. In the compound soil with the ratio of arsenic rock zone to sand 1:5, the total organic carbon content of the soil decreased with the increase of the depth of the soil layer. The total organic carbon content was the largest in the 0-10 cm soil layer, which was 2.07 g/kg. It is 9.52% and 38.93% higher than the 10-20 cm and 20-30 cm soil layers, respectively.

The total organic carbon content in the soils of each compounded soil is arsenic rock zone and sand 0:1 > arsenic rock zone and sand 1:2 > arsenic rock zone and sand 1:5 > arsenic rock zone and sand 1:1, the value is 2.46 g/kg, 192 g/kg, 1.82 g/kg, 1.81 g/kg. It can be seen that the ratio of the total organic carbon content of the compound soil of the 1:5 ratio of the arsenic rock zone to the sand and the 1:1 ratio of the arsenic rock zone to the sand is smaller than the compound soil with the ratio of the arsenic rock zone to the sand 1:2.

![Figure 1. Two-year soil TOC distribution map](image)

In the compound soil after crop rotation, the soil water-soluble organic carbon content of sand soil is lower than that of different proportions of soil in each soil layer. It may be that there are more soil pores in sand and water-soluble organic carbon is easy to leaching. The content of water-soluble organic carbon in the soil decreased firstly and then increased with the increase of soil depth. The water-soluble organic carbon content was the largest in the 0-10 cm soil layer, which was 0.74 g/kg, which was 10-20 cm and 20-30 cm. The soil layer is 5.71% and 2.78% higher respectively. The water-soluble organic carbon in each soil layer accounts for 27.92%, 25.93% and 35.47% of the total organic carbon, respectively. The water-soluble organic carbon in the 20-30 cm soil layer accounts for the highest proportion of total organic carbon. In the compound soil with 1:1 ratio of arsenic rock zone to sand, the content of water-soluble organic carbon in the soil increased first and then decreased with the increase of soil depth. The content of water-soluble organic carbon was the largest in the 10-20 cm soil.
layer, which was 0.84 g/kg, which is 6.33% and 1.20% higher than 0-10 cm and 20-30 cm respectively; the water-soluble organic carbon of each soil layer accounts for 35.43%, 57.93%, 47.43% and 10-20 cm of total organic carbon, respectively. The ratio of water-soluble organic carbon to total organic carbon is the highest, and that of 0-10 cm is the lowest. In the compound soil with ratio of arsenic rock zone to sand 1:2, the content of water-soluble organic carbon in soil increased with the depth of soil layer, and the content of water-soluble organic carbon was the largest in 20-30 cm soil layer, which was 0.80 g/kg. The soil layers of -10 cm and 20-30 cm are 9.33% and 3.80% higher respectively; the water-soluble organic carbon of each soil layer accounts for 36.76%, 43.89% and 43.16% of the total organic carbon, respectively, and is also the water-soluble organic of 10-20 cm soil layer. Carbon accounts for the highest proportion of total organic carbon. In the compound soil with ratio of arsenic rock zone to sand 1:5, the content of water-soluble organic carbon in soil decreases with the increase of soil depth, and the content of water-soluble organic carbon is the largest in 0-10 cm soil layer, which is 0.81 g/kg. The water-soluble organic carbon of the layer accounts for 39.13%, 42.86%, and 54.36% of the total organic carbon, respectively, and the water-soluble organic carbon of the 20-30 cm soil layer accounts for the highest proportion of total organic carbon.

The average water-soluble organic carbon content of soil in each compound soil was 0.72 g/kg, 0.82 g/kg, 0.79 g/kg, and 0.81 g/kg, which was characterized by arsenic rock zone and sand 1:1 > arsenic rock zone and sand 1:5 > arsenic rock zone and sand 1:2 > arsenic rock zone and sand 0:1; soil water-soluble organic carbon content in each compound soil accounted for 29.27%, 45.30%, 41.36%, 44.51% of total organic carbon, respectively, and sand 1:1 > arsenic rock zone and sand 1:5 > arsenic rock zone and sand 1:2 and both are larger than arsenic rock zone and sand 0:1, arsenic rock zone and sand 1:1 compound soil arsenic rock zone has clay characteristics [10], after the formation of compound soil, the ventilating pores of the soil decreased, the capillary pores increased, the water leaching decreased, and the water-soluble organic carbon content increased.

![Figure 2. Two-year soil DOC distribution map](image-url)
Soil oxidizable organic carbon is one of the soil organic carbon components, which is very sensitive to external environmental changes, reflecting the effectiveness and timeliness of SOC to varying degrees [11]. The amount of soil EOC can characterize the stability of soil carbon. At the same time, the stability of soil carbon can be characterized by the ratio of soil EOC to SOC. The greater the ratio of soil EOC to SOC, the greater the soil carbon activity and the more carbon stability. In the compound soil, the content of easily oxidized organic carbon in the soil of sand is lower than that of other proportions in all soil layers, and is only distributed in a small amount in 10-20 cm soil layer. The content of easily oxidized organic carbon in other soil layers is close to 0, sandy soil. Medium organic carbon has good stability and poor activity. In the compound soil with 1:1 ratio of arsenic rock zone to sand, the content of easily oxidized organic carbon in the soil decreased first and then increased with the increase of soil depth. The content of easily oxidizable organic carbon was the largest in the 0-10cm soil layer, which was 0.79 g/kg, 12.26% and 11.27% higher than the 10-20cm and 20-30cm soil layers respectively; the easily oxidizable organic carbon in each soil layer accounts for 35.43%, 48.28%, 40.57%, 10-20cm soil layer of total organic carbon, respectively. The oxidizable organic carbon accounts for the highest proportion of total organic carbon, and the lowest is 0-10 cm. In the compound soil with the ratio of arsenic rock zone to sand 1:2, the content of easily oxidized organic carbon in the soil also increased first and then decreased with the increase of soil depth. The content of easily oxidizable organic carbon was the largest in the 10-20 cm soil layer, which was 1.10g/kg, which is 7.27% and 20.88% higher than 0-10cm and 20-30cm soil layers respectively; the easily oxidizable organic carbon of each soil layer accounts for 50.00%, 61.11%, 47.89% of total organic carbon, respectively, and is also 10-20cm. The oxidizable organic carbon in the soil layer accounts for the highest proportion of total organic carbon. In the compound soil with the ratio of arsenic rock zone to sand 1:5, the content of easily oxidized organic carbon in soil showed a trend of decreasing first and then increasing with the increase of soil depth. The content of easily oxidizable organic carbon was the largest in 20-30cm soil layer. 0.85g/kg, which is 1.19% and 14.86% higher than 0-10cm and 10-20cm soil layers respectively; the easily oxidizable organic carbon of each soil layer accounts for 40.57%, 39.15%, 57.05% and 20-30cm of total organic carbon, respectively. The layer of oxidizable organic carbon accounts for the highest proportion of total organic carbon. The average content of easily oxidizable organic carbon in soils of various compound soils was 0.04g/kg, 0.73g/kg, 1.01g/kg, and 0.81g/kg, which was characterized by arsenic rock zone and sand 1:2> arsenic rock zone and sand 1:5 > arsenic rock zone and sand 1:1> arsenic rock zone and sand 0:1; soil easily oxidized organic carbon content in each compound soil accounted for 1.63%, 40.33%, 52.60%, 44.51% of total organic carbon, respectively, showing arsenic rock zone And sand 1:2> arsenic rock zone and sand 1:5> arsenic rock zone and sand 1:1 and are much larger than arsenic rock zone and sand 0:1. The results showed that among the compound soils, the activity of organic carbon in the compound soil with the ratio of arsenic rock zone to sand 1:2 was the highest, and the stability of organic carbon in sand was the highest.
4. Discussion and conclusion

With the rotation of crops, the organic carbon in different proportions of arsenic rock zone and sand compounded soils showed different degrees of change. As far as the soil layer is concerned, the higher the content of strontium arsenic rock zone in each compound soil, the closer the peak of water-soluble organic carbon is to the surface layer, and the maximum value of water-soluble organic carbon in the compound soil of sand and arsenic rock zone and sand 1:5 ratio appears in the soil layer. The surface layer may be due to the high content of sand in the soil, and the water-soluble organic carbon migrates faster, and the peak may appear below the 30 cm soil layer. The content of easily oxidized organic carbon and the proportion of total organic carbon in sandy soil is the lowest, and the stability of organic carbon is the highest. The content of easily oxidized organic carbon and the proportion of total organic carbon in the compound soil of arsenic rock zone and sand 1:2 ratio is the highest, organic carbon has the lowest stability. The content of polysaccharides in the aggregated aggregates in different proportions of soil and calcium carbonate in the sands of arsenic rock zone and sand 0:1 is higher, and the content of the compounded soil is the highest in the compound soil of arsenic rock zone and sand 1:2. The two types of cemented materials in the compound soil of arsenic rock zone and sand 1:5 are the lowest, agglomerates Poor stability and low level of soil development [12].

Organic carbon content was closely related to crop yield. After the crop rotation, the total organic carbon, oxidizable organic carbon in the compound soil of arsenic rock zone and sand 1:2 showed the best in different proportions of mixed soil, indicating that the soil developed well and the degree of ripening while the development of other proportions of compound soil decreased. However, this test only carried out the determination of organic carbon and water-stable agglomerate cementing materials, but did not combine the actual crop yield and other physical and chemical properties in the soil, so further research is needed.

Figure 3. Two-year soil ROC distribution map
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