

Use of Different Soil amendment to Improve Soil Organic Matter and Crop Yield in Hollow Village Reclamation

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Abstract. Effect of adding different material as amendment on soil organic matter and winter wheat yield was investigated in a field experiment in homestead reclamation in Shaanxi province in 2015. Treatments includes seven pattern of adding different soil amendment (fly ash (TC), organic manure (TF), curing agent (TS), curing agent + fly ash (TSC), fly ash + organic fertilizer (TFC), curing agent+ organic fertilizer (TSF)) Adding soil amendments increased soil organic matter, the TFC treatment showed the best effect of all amendment treatments on soil organic matter. The TFC treatment showed the best effect of all amendment treatments on winter wheat yield. There were significant positively correlation between wheat yield and surface soil organic matter.

1. Introduction

With the increase of rural population in urban employment, non-agricultural population shifts, rural houses are vacant, and the phenomenon of rural hollowing-out is formed. Abandoned homestead cause the waste and inefficient utilization of rural land resources, which hinders the sustainable development of rural economy and society. The destruction and waste of land resources is serious[1]. The renovation of abandoned homestead in hollow village is an important way to increase farmland and relieve people's contradictions [2].

Soil curing agent contains all the trace elements needed by the crops, its main effective component is ferrous sulphate. It's non-toxic, non-polluting, and has the strong improving effect on the soil of raw soil, thin soil and harden soil. Application of soil curing agent by direct and indirect effect to reduce soil bulk density, increase soil porosity, loose soil, increase soil nutrient, improving soil structure and soil water environment[3] and crop production. Fly ash contains a variety of nutrients, such as magnesium, potassium, boron etc. For its different sizes and shapes[4], fly ash can significantly improve soil structure, increase the porosity and ground temperature, reduce capacity and inflation rate, enhancing microbial activity to create a good ecological environment for the soil nutrient transformation, moisturizing keep moisture, coordinate the heat, water and fertilizer[5]. The physical properties of fly ash and sand loam are similar, so according to the principle of quality improvement, apply an appropriate amount of fly ash on soil can have improvement effect and the effect of the modified clay is better.

Add single improved material to improve soil quality has long history, and obtain a lot of achievements. But it may bring physical properties balance problems and cause different degree of



negative influence. Therefore, modified materials application is becoming a hot research topic. Soil organic matter content is one of the important indicators to measure the soil fertility. It is important to guide the reclamation work and has the intimate relationship with wheat yield[6,7]. This study explores different improved material for soil organic matter content and impact of production on the homestead reclamation soil, in order to seek the optimal plan which can rapidly promote homestead reclamation soil improvement. And provide a scientific basis for the homestead reclamation soil improvement technology's popularization and application.

2. Materials and methods

2.1 Study area

Test located in Chu yuan village, du village, fu ping county, wei nan city, Shaanxi province. Which belongs to the warm temperate and semihumid zone, average annual rainfall is 472.97 mm, 49 percent is from July to September. The annual evaporation is 1000-1300 mm, Frostless Season is 225 days. Annual mean temperature is 13.40°C, summer maximum temperature is 41.80°C, winter minimum temperature is- 22°C. Total annual light energy radiation is 518.6-535.0 kJ.cm⁻².

2.2 Test design

The trial began in June 2015. The test plot specification is 2m×2m to simulated land condition of homestead reclamation in project implementation area. The soil was excavated 30 cm in situ and backfilled 30 cm raw soil. Bulk density is 1.5-1.6 gcm⁻³. The test soil derived from the homestead demolished in Yuzi river village, cheng cheng county.

Table 1.Test design

Treatment		Dosage
curing agent	TS	600kg ³ hm ⁻²
organic manure	TF	22.5 m ³ hm ⁻²
fly ash	TC	300 m ³ hm ⁻²
curing agent+ organic fertilizer	TSF	600kg ³ hm ⁻² +22.5 m ³ hm ⁻²
fly ash + organic fertilizer	TFC	300 m ³ hm ⁻² +22.5 m ³ hm ⁻²
curing agent + fly ash	TSC	600kg ³ hm ⁻² +300 m ³ hm ⁻²
contrast	T0	0

The hollow village in hilly area of Shaanxi province is mostly alkaline soil (pH is between 8.4 and 8.7). The main component of the modifier is ferrous sulphate. The fly ash source is more convenient from many factories in the area. Spread the fertilizer evenly on the surface and mix evenly. The experimental fertilizer materials were organic fertilizer, curing agent and fly ash. Seven groups of tests were performed, and each group was repeated three times adopt a single and two - way cross - mixing method.

The basic physical and chemical properties of 0-20 cm soil before the experiment as the following. The organic matter is 4.18 gkg⁻¹, total nitrogen is 0.36 gkg⁻¹, available potassium is 77 mgkg⁻¹, available phosphorus is 9.7 mgkg⁻¹, pH is 8.27, electrical conductivity is 203 uscm⁻¹, bulk density is 1.32 gkg⁻¹.

Winter wheat was planted on October 20, 2015 and October 12, 2016. The variety is small bend 22. Seeding rate is 105 kg³hm⁻². Diammonium phosphate is 750kg³hm⁻² and urea is 600 kg³hm⁻² when sowing according to the soil nutrient content before seeding.

2.3 Detection method

Sampling with a 3 point mixing method every year when the wheat comes back green. Sampling depth is 105cm and every 15cm sampled. Shrink the mixture sample to 1.5kg and test the sample after wind dried. The soil sample was determined by potassium dichromate method.

Yield in May 30, 2016 winter wheat for the first season and in June 2, 2017 winter wheat for second season. The output is measured by single unit.

2.4 Data processing

Using Microsoft excel to deal with data, charts and using SPSS (PASW Statistics 18) statistical analysis software for statistical analysis of data.

3. Results

3.1 Effects of different modified materials on the organic matter of 0~15cm soil layer

The soil surface organic matter showed an increasing trend and the soil surface was more mature than the bottom layer after two years of fertilization (Table 2). The soil organic matter increased year by year after addition of modified materials and the TFC treatment increase most obviously. The soil organic matter content of TFC treatment was increased by three times compared with before treatment and annual increase is 4.98gKg^{-1} . Soil organic matter content of TF treatment increased 2.3 times and annual increase is 3.90gKg^{-1} .

Table 2. Different modified materials on the organic matter of 0~15cm soil layer

Treatment	Before planting (gKg^{-1})	Planting one year (gKg^{-1})	Planting two years (gKg^{-1})
TC	3.32	8.40 ± 0.34	11.07 ± 0.85
TF	3.32	9.24 ± 0.56	11.12 ± 0.74
TS	3.32	4.04 ± 0.42	7.05 ± 0.32
TSC	3.32	4.46 ± 0.12	7.17 ± 0.31
TFC	3.32	8.00 ± 0.27	13.28 ± 0.44
TSF	3.32	4.50 ± 0.16	8.84 ± 0.28
T0	3.32	3.33 ± 0.29	4.94 ± 0.41

The content of organic matter in 0~15cm soil layer of different modified materials was $\text{TFC} > \text{TF} > \text{TC} > \text{TSF} > \text{TSC} > \text{TS} > \text{T0}$. Shows that adding material can be released to the soil organic matter in the process of soil improvement compared with no added material handling and increase soil organic matter content in different extent and adding organic fertilizer + fly ash effect is best.

3.2 Effects of different modified materials on the organic matter of 0~105cm soil layer

The soil organic matter content and its changes in depth direction of soil layer under different modified materials were shown in figure 1. The soil organic matter content of the plow layer could be increased significantly within two years by adding different types of modified materials.

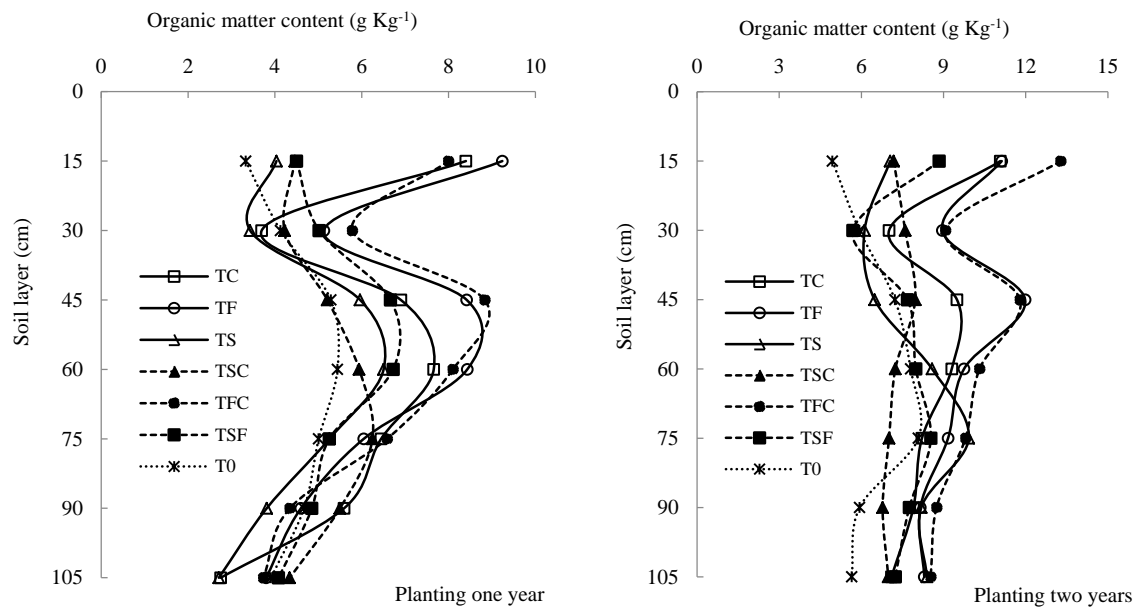


Figure 1. Different modified materials on the organic matter of 0~105cm soil layer

Soil organic matter showed an "S" trend along the soil depth in the first year. That is the surface layer is larger, the minimum value appears at the depth of the 30cm soil layer, and the maximum value is presented at the depth of the 45cm soil layer. The content of organic matter of TF, TC and TFC treatment is not only significantly higher than that of other additives, but also significantly higher in the depth of 45cm and 60cm soil. This may be because the soil layer above 30cm is the newly covered soil. The application of organic fertilizer and fly ash has changed the physical and chemical properties of the soil and improved soil aeration and enhanced microbial activity. The organic matter of TF, TC and TFC treatment was greatly improved in the 45cm soil layer, namely between the raw soil and the basal soil. There was no significant difference in soil organic matter below 60cm soil layer.

The organic matter content of each soil layer was increased along the depth direction, but the overall trend of small "S" was still displayed in the second year. The mean content of the organic matter in the 30cm soil layer increased by 2.1 gKg^{-1} in the first year. The difference in the content of organic matter in the 45cm soil layer was narrowed. It shows that the organic matter content of different soil layers increases gradually with the increase of planting years.

3.3 The influence of different adding material handling on winter wheat yield

Adding material contains abundant plant mineral nutrition needed or useful, also can change soil physical and chemical properties and needed for crop growth nutrients, stimulate or promote crop growth, fertilizer effect eventually embodies in crop yields.

We can draw the yield of winter wheat was increased with the addition of materials compared with T0 and the difference in yield between different additive materials was more obvious (Figure2).

The yield of T0 treatment is the lowest, the yield is 4269 kg hm^{-2} after planting for one year. Application of curing agent and organic fertilizer can significantly increase wheat yield. TSF treatment increased by 1413 kg hm^{-2} compared with T0 treatment and the growth rate was 33%.

TF treatment and TFC treatment increased by 702 kg hm^{-2} and 429 kg hm^{-2} respectively which increased by 16% and 10% compared with T0. It can be seen that organic fertilizers and maturation agents play an important role in increasing wheat yield during maturation. Different materials were added to improve the yield of crops in different degrees compared with T0 in this study.

The yield of T0 treatment decreased by 9% in the second year of planting compared with the first year. TSF treatment, TF treatment and TFC treatment have increased 1627 kg hm^{-2} , 1357 kg hm^{-2} and 1249 kg hm^{-2} and increased obviously compared with T0 treatment.

It is indicated that organic fertilizer can play a long-term role in the process of soil maturation, and it is most obvious to use the curing agent + organic fertilizer to increase the winter wheat yield. The annual growth rate of TS treatment and TSF treatment was negative, it's -8% and -3% compared with the first year of planting. That is these two processing yields have been reduced in different magnitudes. It is indicated that the persistent effect of the fertilizer in addition materials is gradually weakening. It should be added before planting to replenish its nutrient to make crop yield growth trends.

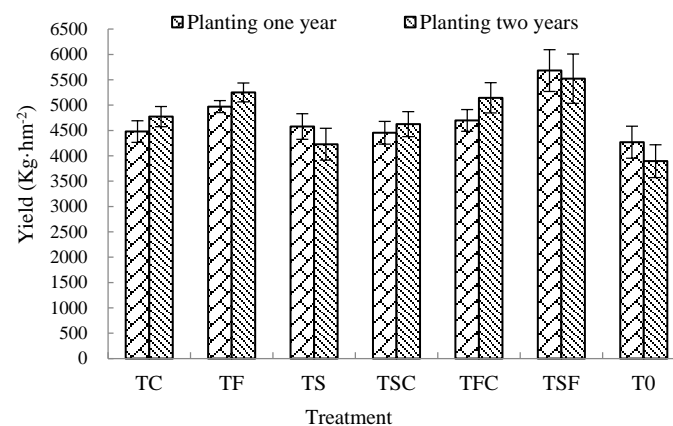


Figure 2. Different adding material on winter wheat yield

3.4 The relation between surface soil organic matter and yield Different adding material handling

Analyze the correlation of organic matter content and yield of two years continuous planting. The relationship between crop yield and soil organic matter of 0~15cm was obtained $y = -1.8084x^2 + 105.87x + 4039.7$, $R^2 = 0.7767$. Y and x are respectively the yield and soil surface organic matter content. The correlation coefficient was 0.7767 and the yield and the organic matter of the top soil layer were significant ($P < 0.05$) after correlation analysis. This indicates that top soil organic matter is an important factor controlling soil productivity and quality. On the other hand, increasing the content of topsoil organic matter can increase crop yield. This also explains the high content of organic matter treatment of organic fertilizer and the high yield of crops.

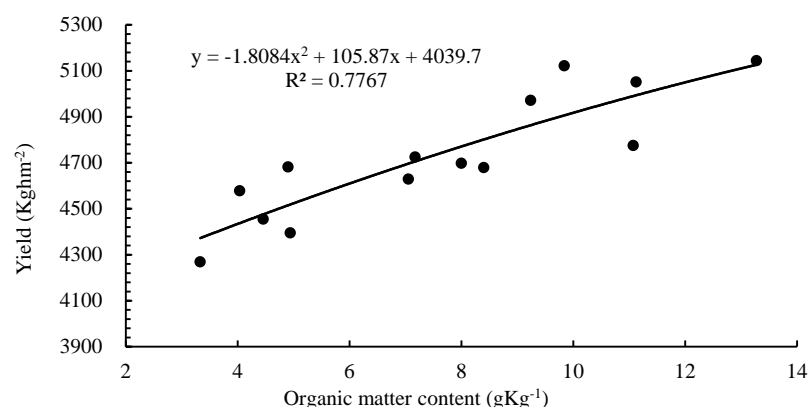


Figure 3. The relation between surface soil organic matter and yield

4. Conclusions

(1) The content of organic matter in 0~15cm soil layer was increased and the soil surface was more mature than the bottom layer after two years planting. The addition of modified material improved the organic matter content of soil surface in different degrees and adding organic fertilizer + fly ash treatment improving effect was the best.

(2) The addition of different material treatments increased yield in different degrees. Organic fertilizer and maturation agent significantly increased wheat yield in the process of soil maturation after one year planting. The wheat yield was steadily increased on the basis of the first year in addition to TS treatment and TSF treatment.

(3) Yield and organic matter in topsoil showed significant positive correlation and increasing the content of organic matter in topsoil could increase crop yield.

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6. References

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