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EFFECTS OF THICKNESS OF TOPSOIL AND NUTRIENTS ON WHEAT YIELD AT RECLAIMED DEPOSITED FLY ASH SOILS IN THE MINING AREA OF HUAINAN CITY

1. General information of test site

The test site locates in the north of Huainan city Anhui province. The area, denominates shangyao-L, is reclaimed by fly ash in the year 1999. It belongs to shangyao government, but be used by one farmer for agriculture recently. The famer uses the reclamation land for soy bean from June to August then transfers to wheat from October to next June.

The investigation fixes on the period of growing wheat. The depth of plow about 35 cm and fertilized for twice every year. First time begin at the end of October. The amount of 25 kg urea and 25 kg mixed fertilizer are used together as basic fertilizer. Urea which contenting 46 percent nitrogen and mixed fertilizer which contenting fifteen percent nitrogen, potassium and phosphorus respectively are used per 666.7 m². Second time is at the beginning of March, use 10 kg urea per 666.7 m². Only one time irrigation takes place at the end of December. The crop yield of this field about 425 kg per 666.7 m².

2. Materials and methods

Firstly, a raster is put on the test site. The soil survey at this field results in an overall range of topsoil thickness of 20 to 93 cm. Four thickness classes are delimited.

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Test field A: < 40 cm (low), Test field B: 40–55 cm (medium), Test field C: 55–70 cm (high), Test field D: > 70 cm (very high). Take three replicates of every class. The size of test field is 5 m × 2 m. 15–20 times push probes per Field for mixed sample.

Meanwhile, one profile is dug from different thickness of classes, taking 5 cylinders which content is 100 cm³ and more than 200 g mixed sample in a plastic bag per horizon. Set 3 plots inside test field which size is 1 m × 1 m which for investigating the influence of fertilizer supply, interval of every plot is 0.5 m.

The study starts at April, according to the local condition, urea which contenting 46% nitrogen is needed as additional fertilizer during this period. We set the fertilizing level from variation of every field. Urea is solved in water and sprayed to the plot ground. The distribution of plots as Figure 1.

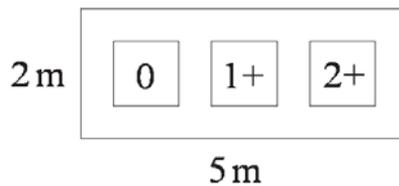


Fig. 1. Plots of test field. Annotation: 0 is no extra; 1+ is with 7.5 g urea equal to 50% extra; 2+ is with 15 g urea equal to 100% extra

2.1. Soil pH value spatial distribution condition

Soil pH value expresses the activity of the hydrogen ions in the soil solution. It affects the availability of mineral nutrients to plants as well as many soil processes. It defines the existed quantity of acidic ions or alkaline ions, effects the formation of the soil physical and chemical properties and the activity of microorganism. Soil pH value in China mostly ranges from 4.5 to 8.5, different regions in bigger difference in general.

Nutrient availability is controlled by soil pH value. *N* is supplied as ammonium (NH_4) or nitrate (NO_3) in fertilizer amendments, and dissolved *N* will have the highest concentrations in soil with pH 6–8. Concentration of available *N* is less sensitive to pH value than concentration of available *P*. In order for *P* to be available for plants, soil pH value needs to be in the range 6.0 and 7.5. If pH value is lower than 6, *P* starts forming insoluble compounds with iron (*Fe*) and aluminum (*Al*) and if pH value is higher than 7.5 *P* starts forming insoluble compounds with calcium (*Ca*).

Four replicates are taken for every kind of soil thickness, all replicates are analyzed for pH value per horizon. The pH value is determined with ten gram of dried and sieved (2 mm) soil in 50 ml of pure water. The analysis is done according to ISO 10390 (1994).

The evaluation is carried out according to AG BODEN 2005.

TABLE 1
Spatial distribution map of pH mean value

Horizon Top soil(cm)	Horizon1	Horizon2	Horizon3
< 40	7.94	8.08	8.32
40-55	7.92	8.09	8.27
55-70	7.92	8.09	8.26
> 70	7.88	8.05	8.19

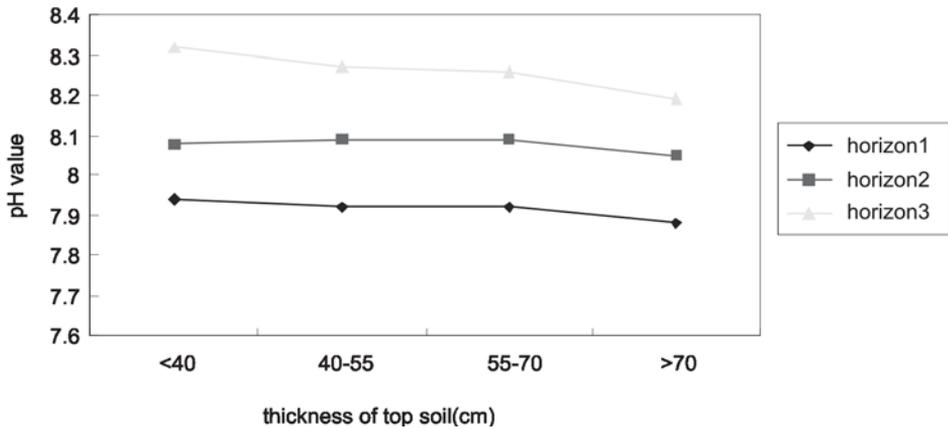


Fig. 2. Spatial distributions of pH mean value

It shows slightly alkaline pH value from 7.88 to 8.32. It can be seen that pH value is decreasing with thickness of top soil. Compare with the pH value of identical thickness of topsoil, pH value is increasing from horizon1 to horizon3. It can be deduced that alkaline mainly exist in fly ash. After long time tillage, top soil which is thinner will be mixed with fly ash, inducing the increase of pH value. It can be seen that the thickness of top soil influences the pH value of growth of wheat.

2.2. Soil Moisture Characteristic Curve

Soil Moisture Characteristic Curve is the important index of describing the relationship between water content and available of absorption. The water runs off by gravity as the pF value ranging from 0.4 to 0.8, hardly to be absorbed by wheat. The pF value which appropriate for wheat is more than 1.8.

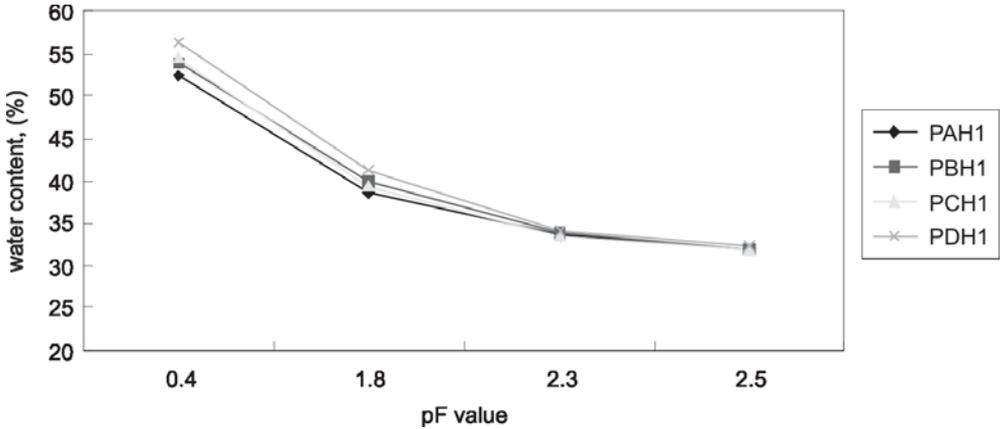


Fig. 3. pF value of horizon1 of different thickness of top soil

It can be seen that, water content decreases with the depth of top soil ranging from 0.4 to 1.8. After that, no clear different with depth of top soil. So that, the water which good for wheat of horizon1 is not obviously influenced by the depth of top soil.

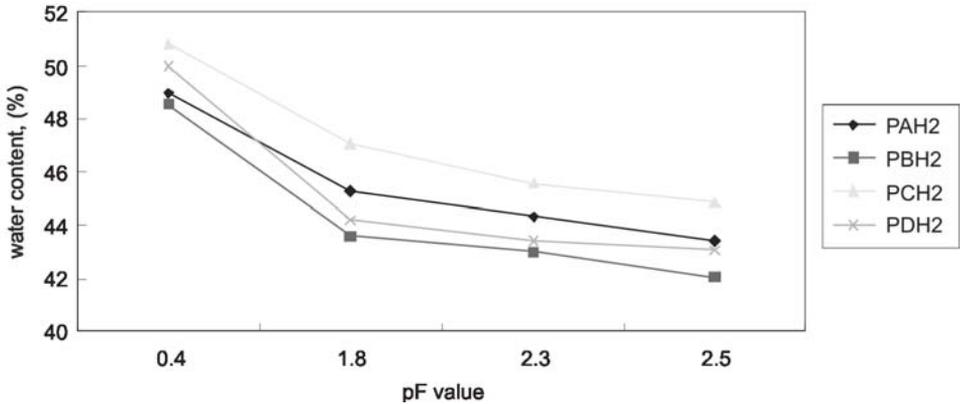


Fig. 4. pF value of horizon2 of different thickness of top soil

From this figure, it can be seen that the depth of top soil ranging from 55 to 70 cm is suitable for preserving water of horizon2.

From this figure, it can be seen that the depth of top soil ranging from 55 to 70 cm is suitable for preserving water of horizon3.

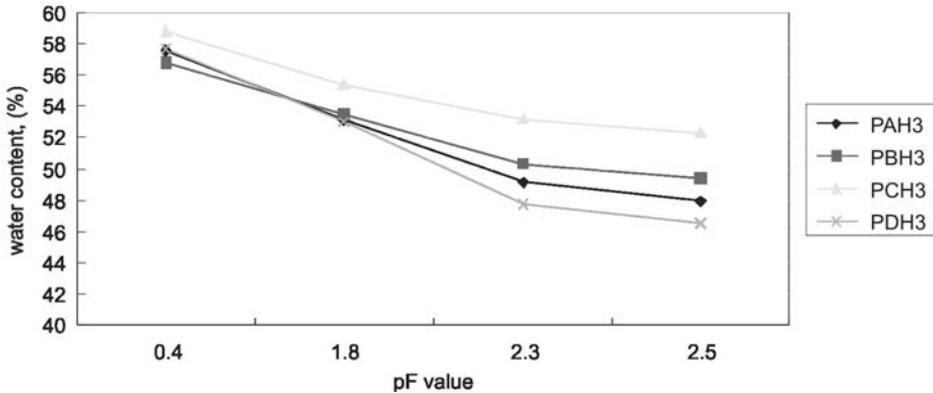


Fig. 5. pF value of horizon3 of different thickness of top soil

2.3. Height of wheat

The height of wheat is measured for three times before harvest, it is carried in the middle of May. We measure the height of wheat at random inside the plots of different top thickness.

TABLE 2

Mean value of tall of wheat

Top soil (cm) \ 46% urea	<40	40–55	55–70	>70
0	74.17	75.53	72.57	72.33
1+	76.20	73.63	72.83	72.07
2+	80.10	77.57	73.17	72.80

Comparing with different concentration, It can be seen that the height of wheat increases sharply with higher urea as the thickness of top soil under 40 cm. No clear relationship between them as the top soil more thick than 40 cm. On the other aspect, the height of wheat decreases with the depth of top soil. It can be induced that, urea is rapidly available as shallow top soil.

2.4. Relationship between biomass and classes of topsoil

Biomass is the important index reflecting economic benefit of reclamation. We harvest the wheat of every plot, simultaneously, marking the plot with lime and red line for subsequent investigation.

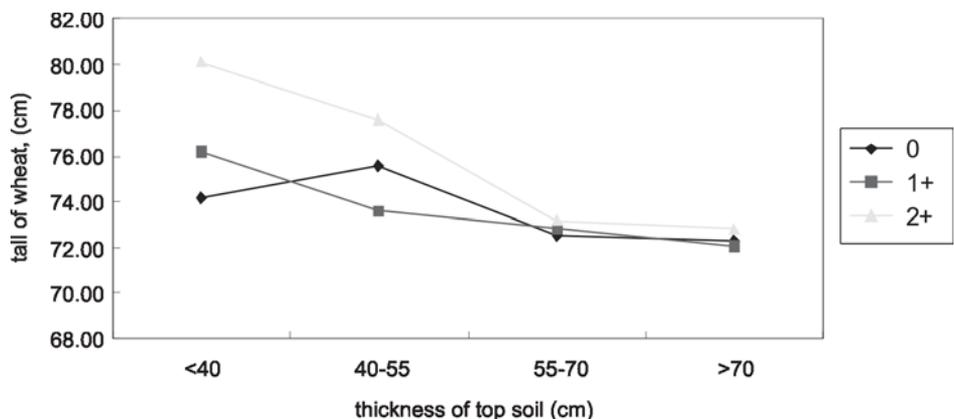


Fig. 6. Mean value of height of wheat

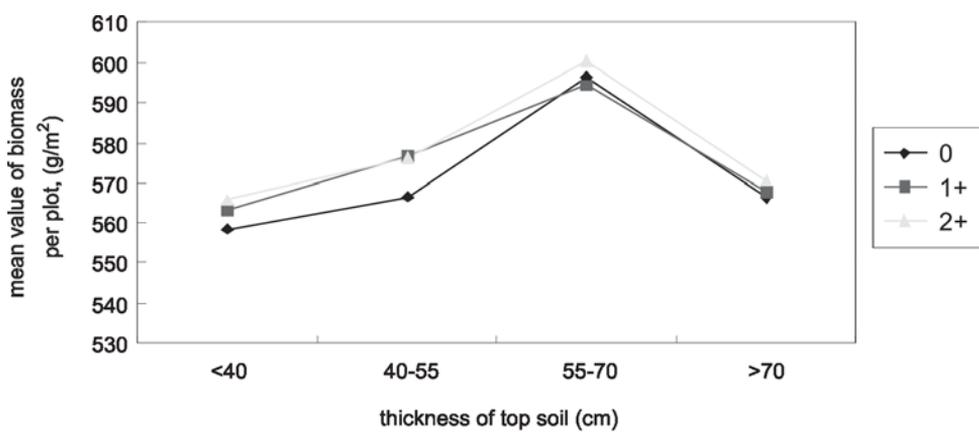


Fig. 7. Mean value of biomass

Comparing with different thickness of top soil, biomass increases with the content of urea at the thickness under 70 cm, then decreases with the depth of top soil. Biomass mean values are basically highest at the thickness of class 3 of every depth of top soil. But thickness of classes 4 doesn't cause an increase of biomass despite of higher amount of top soil.

3. Conclusions

In Huainan city cultivatable land is scarce. Reclamation of subsided area plays an essential role in rebuilding of land.

Considering that pH value of fly ash is normally ranging in the alkaline domain, it decreasing with depth of top soil. Shangyao-L showed slightly alkaline, but it may influence the

absorption of nutrients. Water moisture character curve shows the relationship between water content and available water, it can be seen that the depth of top soil ranging from 55 to 70 cm is suitable for applying water. Height of wheat is effected by the concentration of urea as the top soil is thin, it can be induced that, urea is rapidly available as shallow top soil. Biomass shows highest as the depth of top soil ranging from 55 to 70 cm, displaying intimate relationship with the water retention.

Till now, we have dug profiles of every plot after harvest. Analyzing the index of TOC, nutrient and heavy metal and so on which diverse in different thickness of top soil are our subsequently work. In order to simulate the standardized reclamation procedures that could also be extended to different substrates.

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