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# Available K and total organic C accumulation in soil with the utilization ages of the vegetable greenhouses in the Suburb of Shenyang

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*Abstract*— **The amount of available potassium, total organic C and pH in different utilization age (0, 1, 5, 13-year) vegetable greenhouses soil was examined in Damintun Town of Shenyang. The results showed that the amount of soil available K in all utilization ages vegetable greenhouses decreased with the soil depth. For all the samples, the amount of available potassium (AK) and total organic C (TOC) in the 0-40 cm layer was higher than that in the 40-120 cm. In the 0-20cm layer, the amount of available K in 13-year vegetable greenhouse soil is 3.4 times higher than that in the bare land, while the amount of available K in 1-year vegetable greenhouse is only 1.26 times the than the bare land. The amount of soil total organic C was the biggest in the surface soil (0-20cm) and was in the deep soil (80-120 cm) in the 5-year and 13-year vegetable greenhouse, respectively. It implied that long-term continuous organic carbon input from chemical fertilizer and organic manure could cause total organic C translocation into deep soil layers. Soil pH in the greenhouse has little changed, which indicated that continuous addition of fertilizer has little effect on it.**

***Keywords: available potassium, total organic C, pH, vegetable greenhouse***

## I. INTRODUCTION

Soil nutrient content was influenced by many factors such as parent material, terrain and anthropogenic activity [1], as a substrate for plant root growth and development, soil can continue to supply the necessary nutrients in the process of plant growth. Nutrient availability and distribution features have a strong control action on the growth ability of the ecosystem [2-5]. To understand fully the temporal and spatial variation of soil nutrients is the base of soil nutrient management and reasonable fertilization in the precision agriculture [6, 7]. Potassium (K) is an essential element for crop growth and yield, and it is one of the macroelements whose behavior in soil is controlled by the natural geochemical conditions and by anthropogenic activity [8]. Total organic carbon (TOC) includes two part： dissolved organic carbon(DO) and particulate organic carbon (POC) [9]. It is naturally variable across land use, soil types and climatic zones [10]. Soil pH is a reflection of the important physical and chemical properties of soil quality, and it also has a profound impact on a number of other soil properties. Soil pH was affected by climate, soil parent material, vegetation and human factors, finally formed different soil pH by soil weathering leaching, water and salt movemen， acid and alkaline fertilizer application [11]. Soil pH also affected the soil fertility nutrient availability. In the case of low pH, the availability of P, Ca, Mg are lower. In the case of high pH, trace elements of Fe, Mn, B were not easily absorb by Crops [12]. For high yield and high efficiency, lots of organic manure and chemical fertilizer have been applied in farming, especially in greenhouse cultivation in China. Compared to chemical fertilizer, organic manure can improve the content of soil organic matter at a greater degree [13], and reduce soil erosion [14], and then was widely used for croplands. According to an investigation, the superfluous amount of organic manure was used into greenhouse cultivation in the northern china for the economic benefit from increasing crops yield [15], This may result in nutrients enrichments and the risk of P and N losses from soils [16, 17].

The objectives of the present study presented in this paper are to determine the relationship between soil available potassium (AK) and soil total organic carbon (TOC) content with different utilization ages of the vegetable greenhouses of Shenyang suburb, and analyze the change of pH in soil.

## II. MATERIALS AND METHODS

### *A. Site description*

The study was conducted at a vegetable production base

of Shenyang suburb, Liaoning province, China (41°55.256'N and 122°58.548'E). After more than ten years development, the vegetable production base has became the largest greenhouse vegetable production of Liaoning province. According to the report, by 2010, Liaoning province greenhouse area will reach 270,000 hectares. The base is located in Liao River alluvial plain, and the topography is relatively flat. The soil is gley meadow soil. Cultivars of vegetables in greenhouses are tomato, cucumber (winter and spring), beans and a variety of leafy vegetables (summer and autumn).

According to investigation, the organic manure used in the greenhouses are cow and poultry manures. The usage of the organic manure is about 80~110 t $hm^{-2}$ each year. Other fertilizers used in there are urea (500 kg $hm^{-2}$) or $(NH_4)_2SO_4$ (1000 kg $hm^{-2}$), $(NH_4)_2HPO_4$ (1000~1500 kg $hm^{-2}$), $K_2SO_4$ (1000 kg $hm^{-2}$) and compound fertilizer (1200 kg $hm^{-2}$).

### *B. Sampling and Analysis*

Soil samples was collected from different utilization ages of the vegetable greenhouses at the depth of 0~120 cm with multi-point mixed sampling in 2008. After sampling, soil samples were air-dried and ground to pass through a 2-mm sieve for the determination of available potassium, sub-samples was ground to pass through a 0.25mm sieve for the analysis of soil total organic carbon.

Total organic carbon was measured by using TOC-5000A automatic analyzer (Shimadzu Corporation, Japan). Available K was determined by extraction method with ammonium acetate [18]. Soil pH was determined by a glass electrode pH meter using soil:water ratio of 1:2.5 [19].

The data obtained was analyzed using Microsoft Office Excel 2003.

## III. RESULTS AND DISCUSSION

### *A. Change of available potassium (AK) in the soil profile.*

The amount of available K declined rapidly in the 0-40 cm. In the 0-20 cm soil layer, the amount of soil available K in 13-year vegetable greenhouse was 258.3 $mg \cdot kg^{-1}$, which is 3.43 times higher than that of the bare land, and the amount of available K in 1-year vegetable greenhouse is only 1.26 times the than the bare land. For the bare land, the amount of available K was low, and has little change throughout the 40-120 cm soil layer. For all the treatments, the amount of available K in the 0-40 cm layer was higher than that in the 40-120 cm, which indicated that accumulation of availabel K mainly occurred in 0-40 cm layer. For all the utilization age, the amount change soil available K in13 years of vegetable greenhouse soil is the greatest throughout the 0-120 cm, which implied that long-term continuous K input from chemical fertilizers and organic manure can cause K translocation into deep soil layer.

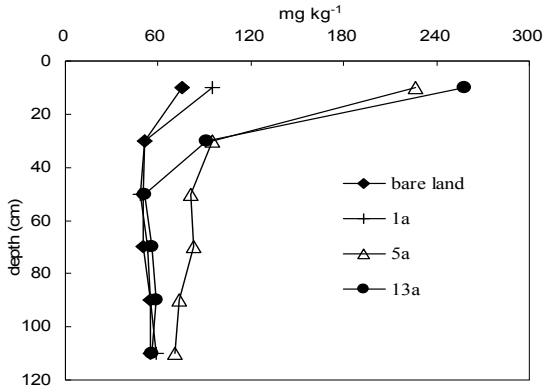


Fig.1. The amount of available K in the soil profile with the utilization ages of the vegetable greenhouses.

### *B. Change of soil total organic carbon (TOC) in the soil profile.*

The amount of soil total organic C in the 5-year vegetable greenhouse was the highest in the 0-20 cm soil layer, and reached about 11$g \cdot kg^{-1}$. The amount of total organic C declined promptly in the 0-40 cm soil layer, especially in the 5-year vegetable greenhouse. With the increase of soil layer continuously, the amount of soil total organic C decreased gradually, that was the biggest in the 60-120 cm soil layer in the 13-year vegetable greenhouse. The amount of soil total organic C was similar in 60-120 cm soil layer in the bare land, 1 and 5-year vegetable greenhouse. The results implied that long-term continuous input of organic carbon from chemical fertilizer and organic manure could cause the translocation of total organic C into deep soil layer.

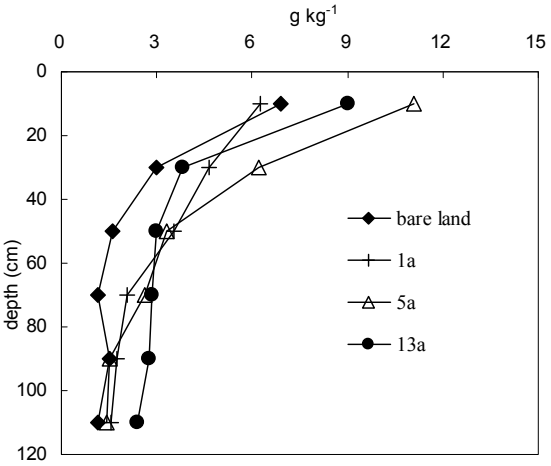


Fig.2. The amount of soil total organic C in the soil profile with the utilization ages of the vegetable greenhouses

*C. Change of soil pH in the soil profile.*

Soil pH varied from 6.56 to 7.31 in the different utilization age of vegetable greenhouse, and the changes of soil pH in 5-year and 13-year vegetable greenhouse were greatly, especially the 13-year vegetable greenhouse. For all the utilization age of vegetable greenhouse, the changes of soil pH were bigger in the 0-80 cm soil layer, and increased with the increasing of utilization age. The results showed that the soil pH has little change with the utilization ages of the vegetable greenhouses, which implied that continuous addition of fertilizer has little effect on soil pH.

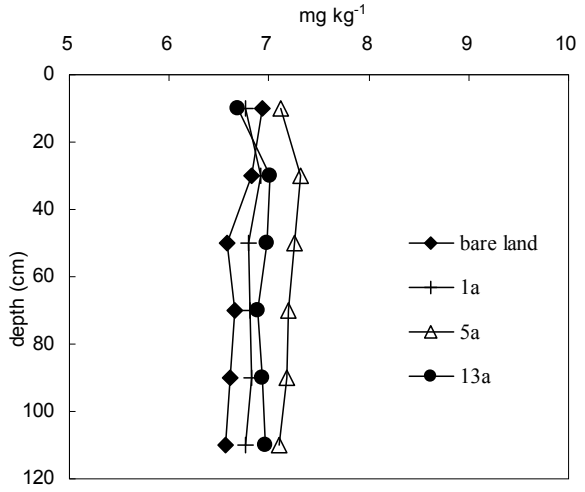


Fig.3. Changes of soil pH in the soil profile with the utilization ages of the vegetable greenhouses.

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