

Characteristics of Salt Crust Layers in the Forests Irrigated With Saline Water in Mobile Desert

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1. Abstract

Salt crust is a special layer, but now the research work on its forming conditions and temporal and spatial rules isn't systematically carried out yet. Through surveying the thickness and electrical conductivity(EC) of salt crust layers in all experimental plots in 2004 and 2005, some conclusions are drawn as the followings:1) The degree of mineralization of irrigating water, irrigation method, irrigation program (irrigation water quota, irrigation interval) and texture of soil have great effects on the features of salt crust;2) The two irrigation ways, i.e. ridge irrigation and drip irrigation, have great effects on the micro-spatial distribution of characteristics of salt crust layers in the forestland. Slope aspects and soil texture and structure also have great effects on the distribution of salt crust; 3) In an irrigation period, the temporal changes of salt crust are very significant. Moreover, with the development of forestland, the thickness of salt crust in the ground surface of forestland tends to be stable gradually, while the EC of it increases firstly and then decreases.

2. Introduction

Soil crust is broadly distributed on the surface of land, especially in arid and semi-arid areas. Soil crust commonly classed physical crust and biologic crust (ZHANG Y M, 2005). Salt crust is universally formed with shallow water table, due to capillary of soil, water and salt accumulated in topsoil and the water evaporation and the salt amassed topsoil. So the author think, salt crust that formed mainly by chemistry should be ranked to chemical crust solely. In research work about salt crust is very poor, moreover, much research work was mainly salt crust of natural condition (Ji F, 2001; Timothy M, 2000), the work about salt crust of irrigation forest area in saline water of desert is fewer, and that many work is attention the rule of water salt movement (ZHOU Z B, 2002).

The experiment plots is located Xiaotang(40°50'N, 84°10'E) and Tazhong(39°00'N, 83°40'E) region in the Taklimakan desert. The area remains with a specially temperate desert land, higher temperature and dry season, the annual in air temperature in summer of 26.8-28.2℃ (HE Q, 1996); the annual evaporation is about from 2000 to 3639mm, the annual average relative humidity is just 35%-55%(HU L Q, 1996). The groundwater is mainly higher mineralization degree with saline and the maximum in mineralization of 28g/l; the soil is composed soil consisting of white, burnt on sand and sub viscosity soil (FENG Q, 1995), and it along the desert highway is mainly aeolian sand soil.

We were carried out a series of experiments to collect many researches work about survival rate, growth and the soil water and salt since 2004 and 2005. The experiments applied irrigation water quality, irrigation water quota; irrigation interval, site conditions and water infiltration through in Aeolian sandy soil and rotten leaf soil. In practice plots, we were carried out 6 spots with the shape of plots; use micrometer to research the thickness of salt crust, all average thickness of spots is the thickness of salt crust. According to quartation method, all samples mixed uniformity and mensurated the EC of salt crust respectively.

3. Results and Analysis

3.1 The degree of mineralization of irrigation water

In order to analysis the distribution of salt crust in different degree of mineralization of irrigation water, some soil samples were collected in September of 2005 from plots, the results shows that the water conductivity was higher than 10g/l, salt crust was easy formed in topsoil(Fig.1a). In the plots of Aeolian sandy soil, there was a relatively connection between the thickness and irrigation water conductivity; but in the plots of Rotten leaf soil, there was no significant relatively, moreover, the relatively coefficient (0.25) is less than Aeolian sandy soil

(0.34) (Fig.1b). when use commonly of water conductivity, the thickness of Rotten leaf soil is more than Aeolian sandy soil.

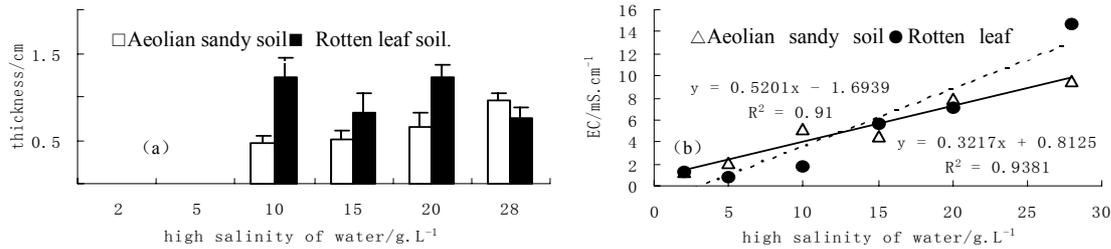


Figure 1 The relationship between thickness, EC of salt crust and degree of mineralization of irrigating

3.2 The irrigation system change of salt crust

3.2.1 Irrigation water quota

The data reveals that the thickness of salt crust is least irrigation when water quota is $1250\text{m}^3/\text{hm}^2$ in two types soil; however, when the irrigation water quota higher or less than $1250\text{m}^3/\text{hm}^2$, the thickness of salt crust was accretion trends (Fig.2a). Moreover, there was different connection between the EC of salt crust and irrigation water quota in two soil types. There was negative relativity in Aeolian sandy soil and positive relativity in rotten leaf soil respectively. But There was no significant correlation between the EC of two soil types when the irrigation water quota were 937.5 and $1250\text{m}^3/\text{hm}^2$ respectively; however, the EC of Rotten leaf soil were higher than Aeolian sandy soil when the irrigation water quota were 1562.5 and $1875\text{m}^3/\text{hm}^2$ (Fig.2b). Considering from salt eluviations, the higher is the irrigation water quota, the less is the salt accumulation in Aeolian sandy soil.

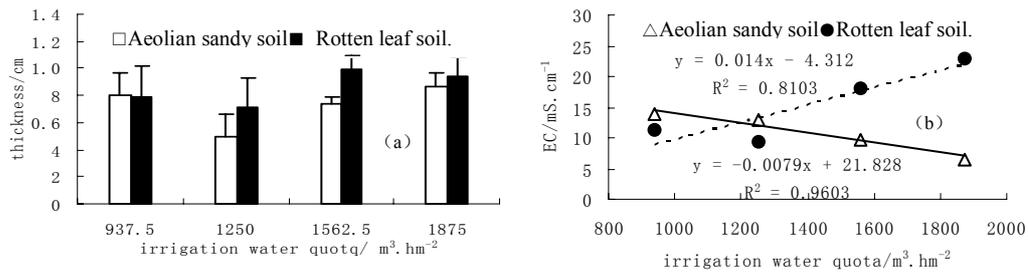


Figure 2 The relationship between the thickness and EC of salt crust and quota of irrigating water

3.2.2 Irrigation interval

When the irrigation interval is 10 days, the thickness of salt crust is the most, and the thickness of salt crust was decreased with prolonging and shortening the irrigation interval. The longer is the irrigation interval, the higher is the thickness of salt crust (Fig.3) in rotten leaf soil. The EC of salt crust was decreased with prolonging the irrigation interval in Aeolian sandy soil, whereas the EC of salt crust was increased firstly, then decreased with prolonging the irrigation interval in Rotten leaf soil, the most value of EC is appeared between the irrigation interval of 15 and 30 days, which indicates that the salt should be concentrated with high frequency irrigation in topsoil.

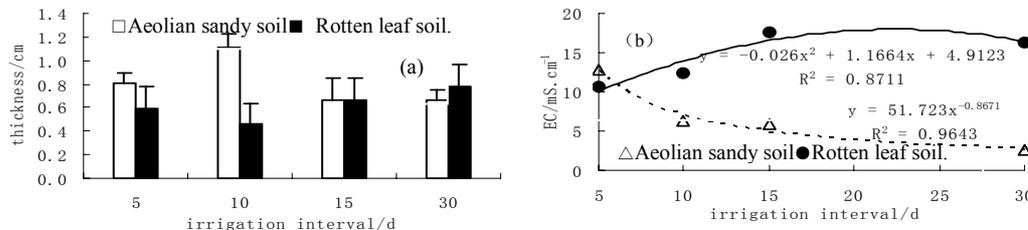


Figure 3 The relationship between the thickness and EC of salt crust and irrigation interval

3.3 The spatial distribution of salt crust

3.3.1 Micro-spatial distribution

The salt crust were formed with forestland in Tazhong zone after drip irrigated, the offwhite of salt crust

was developed around the dripper and becomes circularity with lever direction. We were collected some samples with forestland on August of 2005, the analyses shows that the least was lies the dripper with salt thickness and the EC, with prolonging away from the dripper, the thickness and the EC increased firstly, then decreased and increased again(Fig.4). In the same period, the salt crust was comparatively uniformity distribution in plots, which reveals that the spatial variability of drip irrigation was higher than ridge irrigation and the characteristic of salt crust was comparatively uniformity.

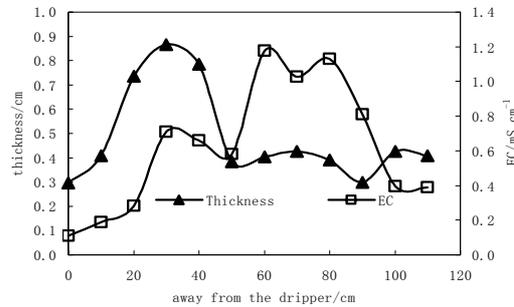


Figure 4 The spatial variation of the thickness and EC of salt crust around dripper

3.4.2 Site distribution

We were selected three haloxylon ammodendron with commonly heighten and the symmetry of shape. The results show that, the thickness of salt crust of Lee slope were more than the wind warp slope, whereas the EC of salt crust was less than the wind warp slope in difference sites. There is no significant difference about the thickness of salt crust between the sunshine slope and the shadow slope, however, due to sunshine slope is easy to receive the radicalization (H. A. Efremova, 1983; CHEN Y Y, 1994), so the EC of salt crust in sunshine slope was more than shadow slope, which leading to salt concentration in topsoil with evaporation.

3.5 The temporal changes of salt crust

3.5.1 Daily changes of salt crust

In irrigation of first day (Fig.5), the EC of two topsoil were a huge of increased, and the EC of Aeolian sandy soil and Rotten leaf soil were increased 30 times and 3.8 times respectively; the EC of topsoil were take on increases firstly, then decreases and levels off, the most value of the EC with salt crust were presented 3 days and 8days in Aeolian sandy soil and Rotten leaf soil respectively. After irrigated 15 days, the EC of topsoil were increased 21.5 times and 2.0 times that of irrigated 1 day.

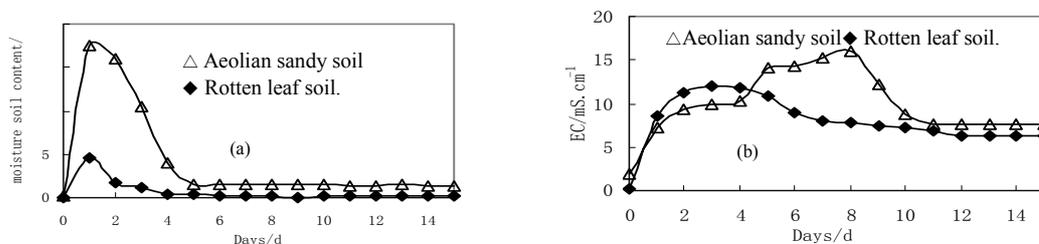


Figure 5 The daily variation of the percent moisture content and EC of topsoil

3.5.2 Seasonal changes of salt crust

We were also collected soil samples on planted season in 2004. The results show that(Fig.6), the least value of the EC was May, and the most value of the EC was July, then decrease on August, which reveals that there was significant correlation between the EC of salt crust and the radicalization, it was also showed that radicalization is a necessary factor with salt concentration. In the same period, we were performed samples under irrigation water quality of 15g/l with the irrigation water quota of 1250m³/hm², there was had sameness trends in planted season, but on July and August, the EC value of salt crust was the less than any months.

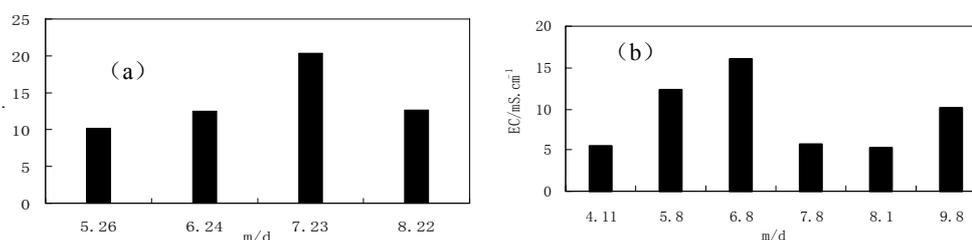


Figure 6 The monthly variation of the EC of salt crust

3.5.3 Years change of salt crust

We were performed plots with four plant years (1995, 1998, 2001 and 2004) in forestland in 2005. The EC of salt crust in the soil is shown in Fig.9. According to surveying, we can found that there was a positive relatively between the litter and the planting years, the annual increase content reached 0.315%, In the middle of level forestland, the teeny silver sand content and powdery sands content were increased 12.69% and 18.85% respectively, whereas the silver sand content and middle sands content were decreased 27.06% and 4.55% respectively(Fig.7). Due to accumulation of litter, the bulk density of salt crust were increased, which leading to the increased of water infiltration, the action of salt concentration were decreased and the salt content becomes decrease with the growth of plant.

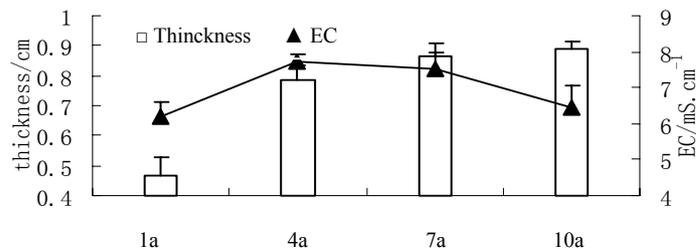


Figure 7 The annually variation of the thickness and EC of salt crust

4. Conclusions and suggestions

From above analysis reveals that, we can receive some conclusions: □The salt crust of topsoil is significant developed in the Taklimakan desert; there is a complex connection between the EC and thickness of salt crust. The salt content is an extremely important function to the depth of salt crust in early days; however, others factor becomes more function and the status of salt content factor is subordination station with the gradually developed of salt crust. □There were significant function to formation and developed of salt crust, such as water quality, irrigation methods, irrigation scheduling and soil texture. □Irrigation methods affects the little spatial distribution of salt crust: The spatial distribution of salt crust is more uniformly in ridge irrigation than drip irrigation; slop directions, soil texture and site conditions the characteristic of salt crust. □Salt crust was significant change with the temporal. In irrigation intervals, the salt content of topsoil and the EC becomes gradually blow, then decreases and stabilities. Salt crust was developed after five days of drip irrigation. Due to evaporation under the change of air temperature, salt crust were significant correlation in planting season, there was developed from Spring to Summer, then decreases from Summer to Autumn; the covered of forestland were obvious influenced the characteristic of salt crust. And added up to abundance of litter and dust deposition, which leading to the rapid increase of the holes in soil, the thickness were became level off and the EC were decreased with the developed of forestland.

5. Reference

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