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Ecological Conditions of Soil Moisture in the Loess Plateau

Lu Zhang [1,2,3,4,5,*], Hongjian Fan [1,2,3,4,5]

[1] Shaanxi Provincial Land Engineering Construction Group, Co., Ltd, Xi'an 710075, China

[2] Institute of Land Engineering and Technology, Shaanxi Provincial Land Engineering Construction Group Co., Ltd.. Xi'an 710021, China

[3] Key Laboratory of Degraded and Unused Land Consolidation Engineering, the ministry of Natural Resources, Xi'an 710021, China

[4] Shaanxi Engineering Research Center of Land Consolidation, China

[5] Land Engineering Technology Innovation Center, Ministry of Natural Resources, China

[*]luluqiaofeng@126.com

Abstract

The Loess Plateau has a dry climate and low rainfall, which affects plant growth and the sustainable development of local soil. This paper focuses on the analysis of soil moisture and ecological conditions on the Loess Plateau to improve data support for related and further research.

Keywords

Natural Precipitation; Atmospheric Evapotranspiration; Soil Moisture Properties.

1. Introduction

The Loess Plateau is located in the north-central part of China and is one of the four major plateaus in China. The Loess Plateau in a broad sense is the loess area, with a loess area of 635,000 square kilometers, including 381,000 square kilometers of primary loess and 254,000 square kilometers of secondary loess. Plateau and Hetao Plain; Loess Plateau in a narrow sense roughly starts from the Great Wall in the north, Qinling Mountains in the south, Wushaoling Mountains in the west, and Taihang Mountains in the east, including most of Shanxi, central and northern Shaanxi, central and eastern Gansu, and southern Ningxia. and eastern Qinghai, with an area of about 300,000 square kilometers.

2. Soil Moisture Ecological Conditions

2.1. Natural Precipitation

Due to the influence of the monsoon on the Loess Plateau, the precipitation in the rainy season and the dry season is significantly different. The average annual rainfall is 200~600mm. The rainy season is mainly concentrated in July, August and September, and the precipitation in this period is as much as 50~80% of the annual precipitation. %, the dry season is from October to June of the following year (Comprehensive Expedition Team of the Loess Plateau of the Chinese Academy of Sciences, 1992). On the one hand, the rainfall characteristic of the Loess Plateau is that the rain and heat are in the same season, which is beneficial to the growth of plants.

2.2. Atmospheric Evapotranspiration

The Loess Plateau is rich in light and heat resources, which are beneficial to plant growth, but have high evaporation intensity. According to statistics, the maximum evapotranspiration of farmland in this area is 750-950 mm per year (Zhang and Shangguan, 2002), which is

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significantly higher than the average precipitation for many years. Therefore, water conditions are one of the main limiting factors for plant growth and layout in the Loess Plateau.

2.3. Soil Moisture Properties

Table 1. Soil moisture properties in the Loess Plateau

Nature	Tight sand belt	Sandy soil belt	Light soil belt	Middle Soil I Belt	Middle Soil Zone II	Heavy soil zone
Sand % (>0.05)	65~80	40~60	20~25	10~15	5~10	3~8
Silty % (0.05-0.001)	10~25	20~50	60~70	65~75	65~75	65~75
Clay % (<0.001)	4~6	5~10	10~15	15~18	18~25	20~28
Test weight /g·cm-3	1.45	1.35	1.25	1.30	1.30	1.35
Field capacity /%	11~14	16~18	18~20	20~22	20~22	20~24
Tianchi suction /bar	0.1	0.2	0.3	0.5	0.6	0.6
Withering coefficient /%	2.5~3.0	3.0~4.0	4.0~5.0	5.0~7.0	7.0~8.0	8.0~13.0
Effective water /%	8~11	13~14	14~16	14~16	13~15	12~16
<1bar Effective water percentage /%	>65	60~65	50~60	10~15	8~10	<8
Unsaturated hydraulic conductivityK(θ)/cm·day-1	$3.2\times10^{-4}e^{77.5\theta}$	$3.4\times10^{-10}e^{83\theta}$	\	$1.5\times10^{-9}e^{71.3\theta}$	\	$2.7\times10^{-8}e^{47.3\theta}$
Moisture characteristic curve	$9.6\times10^{-5}\theta^{-3.5}$	$1.95\times10^{-3}\theta^{-2.83}$	$7.79\times10^{-4}\theta^{-3.68}$	$1.29\times10^{-3}\theta^{-3.5}$	$4.88\times10^{-4}\theta^{-4.12}$	$6.19\times10^{-4}\theta^{-4.36}$

The Loess Plateau has loose soil, uniform texture and high water holding capacity. The soil moisture properties are summarized in Table 1 by texture zone. The Loess Plateau shows regular changes in soil moisture properties from sandy soil to heavy soil zone. It can be seen from Table 1 that the soil available water content in the Loess Plateau is mostly 12-15%. Based on the 200cm soil layer of the main water supply layer where plants need water, the soil water storage capacity of the Loess Plateau can reach 450-600mm. For the Loess Plateau of 200-600 mm, all the precipitation can be stored, and the problem of deep seepage generally does not occur (Han et al., 1990). Therefore, the deep Loess Plateau can be regarded as a soil reservoir with great potential, which has the functions of accumulating precipitation, long-term preservation, regulating flood and dry conditions, and continuously supplying plants. However,

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at the same time, the soil of the Loess Plateau is loose and porous, with developed capillary pores, which is extremely evaporative and easy to lose water (Li, 1983). Therefore, Li Fengmin and others believed that although the soil of the Loess Plateau has a strong water storage capacity, the water retention capacity is poor, and regarded it as a large The capacity of the reservoir is biased. Studies by Li Kaiyuan and others also showed that precipitation, whether in wet years or dry years, cannot be fully conserved by soil until it is used by crops in the next year, and soil only plays a role in regulating and redistributing limited precipitation during the growth period (Li et al., 1990).

It can be seen from Table 1 that the field water holding capacity increases with the heavier texture, but the change in the light loam soil is not large, and the wilting coefficient increases completely with the heavier texture; The proportion of the high water potential (low suction) part, the lighter the texture, the greater the texture; the slope of the soil moisture characteristic curve is steeper for the light soil. Therefore, it is difficult to obtain an exact answer to evaluate soil water performance with a certain index alone. For example, heavy loam soil has higher water holding capacity, but the effective water content is slightly narrower due to the high wilting coefficient; the light soil effective water content range is higher than Wide or high water potential has a larger proportion of available water, but moist soil has high evaporation intensity due to high flux density, which is not conducive to soil moisture retention; ideal soil with good water properties should have high infiltration capacity and The soil has a weak surface migration ability and a large range of effective water. The soil with good granule structure that can combine the three together is the soil with good water properties.

3. Conclusion

To sum up, the soil moisture condition of the Loess Plateau is poor, the natural precipitation is lacking, the atmospheric evapotranspiration capacity is strong, and the soil moisture shape is not good. Therefore, in response to the actual situation of soil moisture in the Loess Plateau, we should carry out targeted management work after grasping the actual problems.

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