Soil Moisture Characteristics of Robinia pseudoacacia Plantations at Different Slope Positions in Zhonggou Small Watershed, Jingchuan, Gansu Province (Postprint)

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Abstract

Taking Robinia pseudoacacia plantations at different slope positions in the Zhonggou small watershed of Jingchuan, Gansu as the research object, the ring knife method was used to determine soil hydrophysical properties and the oven-drying method was used to determine soil moisture content. Analysis of variance indicated that soil physical properties differed significantly among slope positions. Soil bulk density in the 0–100 cm layer was: plateau surface Robinia pseudoacacia plantation (upper) (1.24 g·cm ^{3}) > plateau surface Robinia pseudoacacia plantation (lower) (1.20 g·cm ^{3}) > gully terrace Robinia pseudoacacia plantation (1.18 g·cm ^{3}) > ridge slope Robinia pseudoacacia plantation (1.16 g·cm ^{3}). Total soil porosity followed the order: ridge slope Robinia pseudoacacia plantation (51.99%) > gully terrace Robinia pseudoacacia plantation (51.31%) > plateau surface Robinia pseudoacacia plantation (lower) (50.52%) > plateau surface Robinia pseudoacacia plantation (upper) (49.33%). Both saturated water holding capacity and non-capillary water holding capacity were highest in the ridge slope Robinia pseudoacacia plantation, intermediate in the gully terrace Robinia pseudoacacia plantation and plateau surface Robinia pseudoacacia plantation (lower), and lowest in the plateau surface Robinia pseudoacacia plantation (upper). Seasonal variations in soil moisture were pronounced across all plantations, which could be divided into a soil water consumption period (May–June), a recharge period (July), and a depletion period (August–September). The coefficient of variation of soil water content initially increased then decreased with soil depth, reaching its maximum at 40–80 cm (Cv > 0.3). This indicated that the plateau surface Robinia pseudoacacia plantation (upper) had the highest soil water content, the plateau surface Robinia pseudoacacia plantation (lower) and gully terrace Robinia pseudoacacia plantation had intermediate values, and the ridge slope Robinia pseudoacacia plantation had the lowest soil

moisture.

Full Text

Abstract

The soil hydrophysical properties under artificial *Robinia pseudoacacia* forests in different landforms in a minor drainage basin in Jingchuan County, Gansu Province were measured using the "ring knife" method, and the soil moisture content was also measured using the oven-drying method. The soil bulk density in the 0–100 cm soil layer under the *R. pseudoacacia* plantations at different slope positions was in an order of the *R. pseudoacacia* forest on the hilltop (1.24 g · cm ^{3}) > *R. pseudoacacia* forest at the gully bottom (1.20 g · cm ^{3}) > *R. pseudoacacia* forest (1.18 g · cm ^{3}) > *R. pseudoacacia* forest on the hillslope (1.16 g · cm ^{3}). The total soil porosity was in an order of the *R. pseudoacacia* forest on the hillslope (51.99%) > *R. pseudoacacia* forest in the gully (51.31%) > *R. pseudoacacia* forest at the tableland bottom (50.52%) > *R. pseudoacacia* forest at the tableland top (49.33%). The saturation moisture capacity and non-capillary moisture capacity of soil under the *R. pseudoacacia* forest on the hillslope were both the highest, then those under the *R. pseudoacacia* forests in gully and at the tableland bottom, and they were the lowest under the *R. pseudoacacia* forest on the hilltop. The seasonal variation of soil moisture content under the forest was obvious, which could be divided into the soil moisture consumption period (from May to June), soil moisture supply period (July), and soil moisture reduction period (from August to September). The variable coefficient of soil moisture content under the forests in different landforms was increased at first and then decreased with the increase of soil depth, and it reached the highest value (Cv > 0.3) in the 40–80 cm soil layer. The results revealed that the soil moisture content was the highest under the *R. pseudoacacia* forest on the hilltop, and then under the forests at the gully bottom and the on the gully tableland, and it was the lowest on the hillslope.

Keywords: *Robinia pseudoacacia*; plantation; soil moisture content; hydrophysical property; slope; dynamic change; Gansu Province

1. Introduction

The text contains numerous references to related studies on soil moisture characteristics in the Loess Plateau region. Previous research has examined soil moisture distribution patterns, water conservation functions of forests, and the effects of vegetation on soil properties across different slope positions and land use types.

2. Materials and Methods

2.1 Study Area

The study was conducted in the Zhonggou minor basin of Jingchuan County, Gansu Province. Sample plots were established at different slope positions including hilltop, hillslope, gully bottom, and tableland areas.

2.2 Soil Sampling

Soil samples were collected using the ring knife method. Samples were taken from the 0–100 cm soil profile, divided into layers of 0–10 cm, 10–20 cm, 20–40 cm, 40–60 cm, 60–80 cm, and 80–100 cm. Basic information of the sample plots is shown in Table 1.

2.3 Soil Moisture Measurement

Soil moisture content was measured using the oven-drying method. Samples were oven-dried at 105°C for 12 hours to constant weight.

2.4 Data Analysis

Data were processed using Excel 2010 and SPSS 19.0 software. Duncan' s multiple range test was used for statistical comparisons at P = 0.05 significance level.

3. Results

3.1 Soil Bulk Density and Porosity

Soil bulk density and porosity in the 0–100 cm soil layer under artificial *Robinia pseudoacacia* forest at different slope positions are presented in Table 2.

The soil bulk density showed significant variation among different slope positions. The order of soil bulk density was: hilltop (1.24 g·cm ^{3}) > gully bottom (1.20 g·cm ^{3}) > tableland bottom (1.18 g·cm ^{3}) > hillslope (1.16 g·cm ^{3}). Conversely, total porosity was highest on the hillslope (51.99%), followed by gully bottom (51.31%), tableland bottom (50.52%), and lowest at the hilltop (49.33%).

The saturation moisture capacity and non-capillary moisture capacity were both highest under the hillslope forest, intermediate in gully and tableland bottom forests, and lowest under the hilltop forest.

3.2 Seasonal Variation of Soil Moisture

The seasonal variation of soil moisture content was pronounced, dividing into three distinct periods: soil moisture consumption period (May–June), soil moisture supply period (July), and soil moisture reduction period (August–September). The coefficient of variation for soil moisture content initially increased then decreased with soil depth, reaching maximum values (Cv > 0.3) in the 40-80 cm layer across all landform positions.

References

The references section contains citations to numerous studies on soil moisture dynamics, water conservation functions of forests, and related research in the Loess Plateau region. Key references include studies on hydraulic parameter estimation, soil water characteristics under different vegetation types, and the effects of forest plantations on soil properties.

Note: Several portions of the original text contained significant OCR errors and encoding artifacts that rendered them unreadable. Only the coherent scientific content has been translated and presented above.

Note: Figure translations are in progress. See original paper for figures.

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