1 ,3   1 ,2 , *
,

(1.   ,   712100 ;

2.   ,   712100 ; 3.   ,   100039)

:   ,   2004   5

——   ,   : (1)   ,

(0   15cm)   ,   (15   30cm)   (30   50cm)   ; (2)

,   (p < 0. 001)   ; (3)

,   (p < 0. 001)   (x_1)   (x_2)

(x_3)   ,   : $y = - 4. 89 + 1. 27 x_1 + 0. 079 x_2 + 1. 94 E - 3 x_3$ ($R^2 = 0. 914$

$p < 0. 001$)

:   ;   ;   ;   ;

Soil anti-scouribility during vegetation succession of Ziwuling secondary forest

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Abstract :In China , the Loess Plateau is well known for its high erosion rate and vulnerable ecosystem. The soil erosion by water has been considered the cause of the losses of plant nutrients and productivity , and off-site environmental problems have also become a concern in recent years. Vegetation is the main factor to improve the environment in which soil erosion and water loss occur. High soil erosion rate by water mainly relates to low soil anti-scouribility in the Loess Plateau. A great number of researches about soil anti-scouribility have been conducted in some regions whose vegetations are severely impaired. However , little attention has been paid to the changes of soil anti-scouribility in the succession process of vegetation communities. In the spring of 2004 , five plant communities at different succession stages were investigated in Ziwuling secondary forest of Shaanxi Province. The soil anti-scouribilitys of the communities were measured with their undisturbed soil samples that had been exposed to a flow at a rate of 4 L/min on a washing flume slope of 15° for 15 min , and the root surface areas , water stable soil aggregates and soil microbes of the communities were also measured in the soil sampling plots. The objective of the study was to examine the change of soil anti-scouribility and its relation with the roots , water stable soil aggregates and soil microbes in the process of vegetation succession. The results indicated that : (1) The upper soil layers had a higher soil anti-scouribility than the lower soil layers , and the soil anti-

scouribilitys in the upper soil layers increased with the vegetation successions; nevertheless, the soil anti-scouribilitys did not varied much among different stages of the vegetation successions in the lower soil layers. (2) The soil anti-scouribilitys presented a positive and linear relationship with the root surface areas per unit soil volume, and the root surface areas alone explained more than 78% of the variations in soil anti-scouribility. (3) The water stable soil aggregates and soil microbes also positively affected the soil anti-scouribilitys, and the relationships among them could be expressed in linear equations; and the water stable soil aggregates and soil microbes could explain 93. 5% and 77. 8% of the variations in soil anti-scouribility, respectively. A linear equation to express the effects of the roots, water stable soil aggregates and soil microbes on the soil anti-scouribilitys was obtained by multivariate regression. This study may provide a new perspective for the research on vegetation control of soil erosion by water, and the equation for the soil anti-scouribilitys probably contributes to the development of soil erosion models in the Loess Plateau.

 Key words:vegetation succession; soil anti-scouribility; plant roots; water stable aggregate; soil microbe

,   ,

,

[1]   [2]

,

[3]

,   ,

,   ,

,

[4]

,

[5]

,   ,

,

,

,

1
1. 1

,   109°11 E 36°05 N,   9   ,

576. 17mm,   6   8   60 %   ,   [6]   ,

[7]   1100   1450m,   200   400m,   23000 km² ,

[8]   50m   ,   ,

,

[9]

,   70 %   ,

[10]

:   ,   ,   ,

1

1. 2
1. 2. 1   [11 ,12] ,

70cm   ,   ,   10cm × 10cm × 25cm

0   15cm 16   30cm   30   50cm   3   ,

,   15°,

4L/min ,   15min   1g   ,   AS (Anti-

Scourability)   ,   L·min/g ,AS   ,

1

Table 1   The sampling sites land characters at five vegetation succession stages in Ziwuling

Succession stage	Slope (°)	Orientation		Elevation (m)		Vegetation type
	15°	Valley botton		1130	1185	, *Setaris viridis*
	20°	Mountaintop		1220	1350	*Bothriochloa ischemum* , *Stipa bungeana* , *Themeda triandra* var. *japonica*
	25°	NW45°	NE45°	1250	1345	*Sophora viciifolia* , *Hippophae rhamnoides* , *Rosa hugonis* , *Spiraea pubescens*
	25°	SW30°	SE30°	1230	1340	*Populus davidiana* , *Betula platyphylla*
	30°	SW30°	SE30°	1230	1340	*Quercus liaotungensis* , Artificial *Pinus tabulaeformis*

1.2.2

,   (1 500)   18h
,   (BenQ 5000U)   ,   300dpi ,   ,
8 ,   bmp   CIAS V2.0(CID company ,USA)   ,
, $cm^2 \cdot cm^{-3}$[12]

1.2.3   0   15   15   30cm   30   50cm   ,
,   [13]   > 5   5   2   2   1   1   0.5mm   0.5   0.25mm

1.2.4   0   15   15   30cm   30   50cm   ,
4   ,   [14]

2

2.1

,   (0   15cm)
,   ,
(15   30cm)   (30   50cm)
(1)   [15]
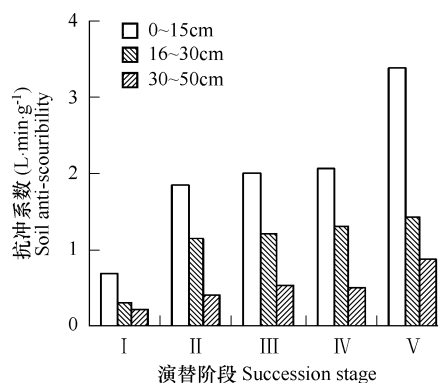

1

Fig. 1   Changes of soil anti-scouribility with vegetation succession stages

,   150a   ,   ,
[17] ,
,   ,   ,

2.2

(2) ,
, $y = 8.266x + 0.5246$ ($R^2 = 0.7881$, $n = 15$) , $p < 0.001$
,   [18]   Wu[19]   (< 1mm)

,Mamo[20,21]

, , Mamo ,

, ;

Wu , ,

,

[22]

, , ,

[23] ,

,

,

,

,

[24] (cm^2 · cm^{-3})

,

,

,

2. 3 (>

0. 25mm) (3) , ,

$$y = 0.0958 x - 6.0119 \ (R^2 = 0.935,\ n = 15),\ p < 0.001$$ Bernard[25]

,

(> 0. 20mm)

[26]

,

, ,

,

[27]

,

,

,

2. 4

, ,

,

,

(4) ,

, ,

,

2
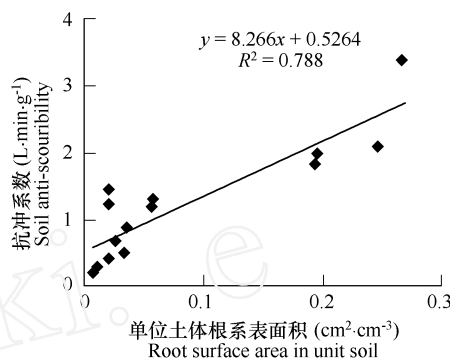
Fig. 2 Relationship between soil anti-scouribility and root surface area
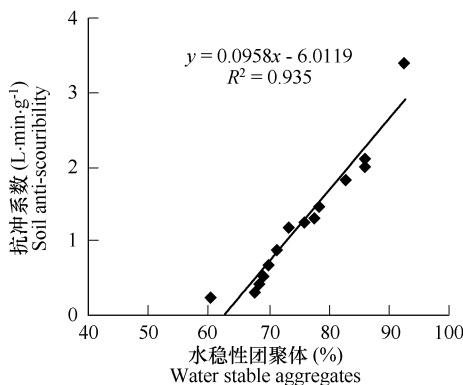

3

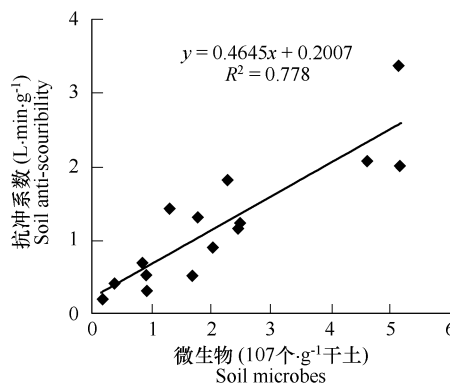Fig. 3 Relationship between soil water stable aggregates and soil anti-scouribility

4

Fig. 4 Relationship between soil microbes and soil anti-scouribility

; [28] [29]

,   ,

,   ,   ,   ,

2.5

[18 21],

SAS   REG   ,   (x_1)   (x_2)   (x_3)

(y)   :

$$y = -4.89 + 1.27 x_1 + 0.079 x_2 + 1.94 E - 3 x_3 \quad (R^2 = 0.914, \ n = 15) \quad p < 0.001$$

3

,   ,   (0 15 cm)   ;   (15 30 cm)

(30 50 cm)   ,

,

,

,

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