Postprint: Fractal Characteristics of Sea Buckthorn Root Systems Under Different Site Conditions in Pisha Sandstone Areas

Authors: Yan Li, Yang Fangshe, Li Huaien, Wang Hao, Wang Dingwu, Yang Fangshe

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Abstract

Based on fractal theory, this study investigated the fractal characteristics of the entire root system, first-order lateral roots, and second-order lateral roots of 3-year-old seabuckthorn artificially planted under different slope aspects and gradients within the Pisha sandstone area, as well as the relationship between seabuckthorn root system growth and development and soil moisture content under different site conditions. The results showed that: The fractal dimension varied as D_east_slope > D_north_slope > D_south_slope > D_west_slope, and D_50° > D_40°. Under different site conditions, D1 (fractal dimension of second-order lateral roots) > D (fractal dimension of entire root system) > D2 (fractal dimension of first-order lateral roots), and D1 was significantly positively correlated with fine root length. The surface soil moisture content on south and west slopes was below 4%, which was unfavorable for root system development, while the moisture content on north and east slopes was relatively high; therefore, the fractal dimensions on north and east slopes were larger. Compared with seabuckthorn grown on north (west) slopes, the moderate water deficit conditions on east (south) slopes stimulated fine roots to grow into deep soil layers to utilize water from those layers. Seabuckthorn could adapt to water-deficient conditions by adjusting root system fractal characteristics, but its growth performance was inferior to that under sufficient water conditions; therefore, the growth status of seabuckthorn was in the order of north slope > east slope > west slope > south slope, and 40° slope > 50° slope. Under different site conditions in the Pisha sandstone area, it is recommended to prioritize north and east slopes for seabuckthorn planting, with west and south slopes as secondary choices, while 50° slopes are unfavorable for seabuckthorn growth.

Full Text

Preamble

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Fractal Features of Hippophae rhamnoides Root under Different Site Conditions in Soft Sandstone Area

YAN Li[1], YANG Fang-she[1,2], LI Huai-en[2], WANG Hao[1], WANG Ding-wu[1]

[1]College of Urban and Environmental Sciences, Northwest University, Xi' an 710127, Shaanxi, China
[2]State Key Laboratory Base of Eco-hydraulic Engineering in Arid Area in Northwest China, Xi' an University of Technology, Xi' an 710048, Shaanxi, China

Abstract

In this paper, the fractal characteristics of the whole-roots, primary lateral roots and secondary lateral roots of three-year-old *Hippophae rhamnoides* planted on different slope aspects and gradients were analyzed based on the fractal theory. The relations between the growth and development of the roots and soil moisture content in a sandstone area were studied. The results are as follows: The variations of fractal dimensions were in orders of DES > DNS > DSS > DWS, D50°S > D40°S, fractal dimensions of secondary lateral roots (D1) > fractal dimensions of whole-roots (D) > fractal dimensions of primary lateral roots (D2) under different site conditions. There was a significant positive correlation between D1 and fine roots length; The topsoil moisture content on the southern and western slopes was lower than 4%, which was not conducive to the development of root system. The soil moisture content on the northern and eastern slopes was high, so the fractal dimensions of these two slopes were higher compared with that for the root growth of *H. rhamnoides* on the northern and western slopes, and the moderate lack of water on the eastern (southern) slope could stimulate the fine roots to grow down to deep soil; *H. rhamnoides* could adapt to the environment through root fractal regulation when water is insufficient, but its growth conditions were not as good as that when water is sufficient. Therefore, the growth conditions were in orders of northern slope > eastern slope > western slope > southern slope, and 40° slope > 50° slope. It is suggested that the priority should be given to the northern and eastern slopes when planting *H. rhamnoides*, and the slope steeper than 50° is not conducive to the growth of *H. rhamnoides*.

Keywords: *Hippophae rhamnoides*; root; fractal dimension; slope stabilization; sandstone area; Inner Mongolia

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