研究论文

西北油松叶片δ^{13}C特征与环境因子和叶片矿质元素的关系

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摘要 选取甘肃、宁夏及内蒙古油松(*Pinus tabulaeformis*)10个天然种群, 通过测定油松叶片稳定碳同位素组成(δ^{13}C)和元素含量等特征, 分析了油松叶片δ13C特征及其与环境气候因子和叶片矿质元素含量之间的关系。研究结果表明, 油松叶片δ^{13}C的变化范围在－28.68‰ － －25.02‰之间, 平均值为－26.82‰; 油松叶片δ^{13}C值与海拔、经度之间相关性不显著, 与纬度之间呈显著正相关, 与年降水量、年平均温度之间均呈显著负相关, 说明年平均温度和年降水量是决定油松13C分馏能力差别及生长的主要限制因子; 叶片元素N、P、K、Si、Ca、Fe含量与δ^{13}C值有明显的相关性, 其中叶片N、P、K含量与δ^{13}C值显著负相关, Si、Ca、Fe含量与δ^{13}C值显著正相关, 可见不同种群间δ^{13}C组成差异可反映植物营养元素含量的变化状况。不同生境条件下环境气候因子和矿质元素含量的这种响应模式在一定程度上反映和影响了以油松为建群种和优势种的生态系统的δ^{13}C变化特性。

关键词: 相关性 环境因子 叶片元素含量 油松 稳定碳同位素组成

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Abstract: *Aims* Our objective was to analyze relationships between foliar stable carbon isotope composition (δ^{13}C) and environmental factors and leaf element contents in *Pinus tabulaeformis*, which is widely distributed in northwestern China.

Methods Leaf samples were taken in ten natural populations of *P. tabulaeformis* from Gansu, Ningxia and Inner Mongolia. The δ^{13}C was determined using an isotope mass spectrometer. Environmental factors were recorded by Magellan GPS320 and from nearby weather stations. Leaf element contents were measured with low vacuum scanning electron microscope and X-ray energy dispersive spectroscopy. Carbon content was estimated with the potassium dichromate method, and nitrogen content was measured with the micro-Kjeldahl method. Data were evaluated with Excel 2003 and SPSS 13.0 analysis of correlation and regression.

Important findings Foliar δ^{13}C ranged from －28.68‰ to －25.02‰, with an average value of －26.82‰. Foliar δ^{13}C did not closely correlate with altitude and longitude, but was significantly positively correlated to latitude and negatively correlated with annual mean precipitation and temperature. Therefore, δ^{13}C in different natural populations of *P. tabulaeformis* is significantly influenced by environmental factors, and annual mean temperature and precipitation are essential factors in δ13C's capability of fractionation and growth. Leaf N, P and K content were significantly negatively correlated with δ^{13}C; however, Si, Ca and Fe content were significantly positively correlated with δ^{13}C. Different δ^{13}C in different natural populations reflects changes in plant nutrient element content. Response mode of climatic factors and element content under different habitat conditions reflected and affected properties of δ^{13}C change in natural populations of *P. tabulaeformis*.

Keywords: correlation, environmental factors, leaf element contents, Pinus tabulaeformis, δ^{13}C

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