Effects of silicon addition on carbon storage and carbon flux of soil and terrestrial plants:a meta-analysis

Yi-Fei Chen[1] De-Xiang Zheng[1*] Shao-Fei Jin[2]

(1 College of forestry, Fujian agriculture and Forestry University, Fuzhou 350002; 2 Department of geography, Minjiang University, Fuzhou 350108;)

Abstract: Silicon fertilizer has been widely used as an important element fertilizer in agricultural and forestry production, and the silicon cycle in the ecosystem is closely related to the carbon cycle. However, it is still unclear how the carbon cycle of terrestrial ecosystems responds to silicon fertilizer application. Here, a meta-analysis method was used to quantify the response ratio of C pools and fluxes in terrestrial ecosystems worldwide to silicon fertilizer application and explore the factors that affect this response. The results showed that silicon fertilizer application significantly increased plant aboveground part C by 19.7%, plant belowground part C by 17.36%, plant total C by 26.7%, litter C by 8.26% and plant phytoliths C by 21.75%, while increasing soil organic C by 7.22%. In addition, silicon fertilizer application significantly increased net photosynthetic rate of plants by 29.14% and net primary productivity of ecosystems by 43.26%, while reducing net CH4 emissions from soil by 29.59%. However, the effect of silicon fertilizer on litter decomposition rate and net soil CO2 emissions from were not significant. Research on influencing factors shows that fertilization objects, climate conditions, and silicon fertilizer application technology all have an impact on the response of C pool and C flux to silicon fertilizer application. Generally speaking, silicon fertilizer application can enhance the carbon sequestration capacity of terrestrial ecosystem by positively stimulating plant net photosynthetic rate, plant C pool, soil organic carbon storage and inhibiting soil CH4 emission. While, appropriate fertilization techniques should be selected according to fertilization objects and environmental factors when applying silicon fertilizer to achieve optimal fertilization effects.

硅肥施用对土壤和陆地植物碳储量及碳通量影响的 Meta 分析

陈逸飞[1]，郑德祥[1*]，靳少非[2]

（1 福建农林大学林学院，福州 350002；2 闽江学院地理科学系，福州 350108）

摘要：硅肥作为重要的元素肥料在农林业生产中得到了广泛应用，且生态系统中硅循环与碳循环密切相关，然而陆地生态系统碳循环如何对硅添加进行响应仍不清楚。本研究使用 Meta 分析研究了全球范围内陆地生态系统中碳库及碳通量对硅添加的响应，并探究了对该响应存在影响的因素。结果表明，硅添加显著增加植物地上碳储量 19.7%、地下碳储量 17.36%、植物总碳储量 26.7%、凋落物碳储量 8.26%及植硅体碳储量 21.75%，同时使土壤有机碳库增加 7.22%。此外，硅肥施用显著增加了植物净初级生产力 29.14%和生态系统净初级生产力 43.26%，同时使土壤甲烷净排放下降了 29.59%，而凋落物分解速率及土壤二氧化碳净排放量对硅添加的响应并不显著。当施肥对象及实验期间气候不同，或采用不同施肥技术施用硅肥时，碳储量及碳通量对硅添加的响应存在差异。总体而言，硅添加可通过对植物净光合速率，植物及土壤有机碳储量产生正向刺激以及抑制土壤甲烷排放等方式，增强陆地生态系统碳汇功能，但在硅肥施用时应根据施肥对象及环境因子选择适宜的施肥技术，以达到最佳的施肥效果。