Silica distribution in various bamboos species and its effects on plant growth

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Abstract

Bamboos are distributed throughout the world's temperate, tropical and subtropical regions. They are widely used in industry, as fresh edible shoots, paper maker, building and even in medicine. Bamboos also play multiple ecologic functions such as soil and water conservation and erosion control. Bamboos have generally high silicon (Si) content. Silicon is known to have beneficial effects on plants and alleviate various stresses. The aim of this study is to quantify the Si uptake and distribution in various bamboos species and to investigate the effects of Si on the plant growth. Two complementary studies were carried out, one under natural conditions and one under controlled conditions. First of all, we performed an inventory of Si tissue content in 16 bamboos species growing in a non-polluted tropical soil at the Reunion Island (France, Indian ocean). We determined Si content in leaf and in stem tissues sampled at several heights for each plant. One of these species Gigantocloa sp « Malay Dwarf » was grown for 3 months in nutrient solution at five Si concentrations (0, 0.25, 0.75, 1.15, 1.5 mM Si). Silica deposition was examined in leaves using a cryo-SEM equipped with EDS. The Si concentration varies significantly between species, depending on rhizome morphology. Bamboos having leptomorph rhizomes show significantly higher leaf and stem Si content than that of species having pachymorph rhizomes. The distribution of Si in the plant has the same trends for all species. Leaves are the most concentrated organs (10.9 %), and within the stem Si concentration significantly increases from the bottom (0.32%) to the top of the plant (2.1%). Plant Si content increases with the Si supply. Leaves of Gigantocloa sp « Malay Dwarf » accumulate 15.2 % of Si under natural conditions and up to 24 % when exposed to the highest Si treatment. Unlike previous studies, our experiment shows that the concentration of Si had no significant effect on nutrient uptake and biomass production. Leaf silica deposition occurs mainly in epidermal cells, micro-hairs, prickles hairs and bulliform cells. A better knowledge of Si distribution in various species and in various tissues into the plant is promising to understand the mechanisms of absorption, transportation and precipitation of Si, and thus its role on the stress tolerance.

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