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# 窒素飽和に伴うタケの倒伏現象：その形態学的ならびに力学的理由
# Bamboo lodging associated with nitrogen saturation: its morphological and mechanical reasons

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[Introduction]
Nitrogen saturation, a situation of available nitrogen in excess of plant and microbial nutritional demand due to nitrogen deposition, has been suggested to affect plant growth and the root-shoot biomass allocation; an increase in foliar biomass and a decrease in fine root biomass under high nitrogen availability (Aber et al. 1989). In recent years, some reports have suggested that tree windthrow damages may be associated with increased nitrogen status (Braun et al., 2003; Meyer et al., 2008). Here, we report a phenomenon of lodging (falling down) of moso bamboo (Phyllostachys pubescens) in a forest site of nitrogen saturation. We suggest that the bamboo lodging is associated with the following morphological and mechanical anomalies; 1) an increase in branches-and-leaves biomass, 2) a decrease in root system, and 3) a decrease in bending strength.

[Materials and methods]
We studied the biometry of bamboo in a nitrogen-saturated site (Tama hill, Tokyo) and control sites (Fukushima and Izu), such as diameter at breast height (DBH), culm height, and mass of branches-and-leaves. Root density and soil nitrate concentration were measured for soil cores 25, 50, 75, 100cm away from culm. The total carbon and total nitrogen content of leaves and culms were measured with dry combustion method. As an index of mechanistic strength, Young's modulus (E) and flexural rigidity (EI) of culm were measured with a bending test of test piece.

[Results and discussion]
In a N-saturated site, leaf and culm nitrogen concentration were significantly higher than control sites. Any elongation growth, which was initially hypothesized, was not observed in a N-saturated site. However, some bamboos in a N-saturated site had significantly larger mass of branches-and-leaves. Very low root density associated with elevated nitrate concentration was also demonstrated, in contrast with a root mat in the soil surface observed in control sites. Culm density and culm thickness showed a negative correlation with bamboo nitrogen concentration. Consequently, culm flexural rigidity (EI) also declined with the increase in nitrogen concentration. A combination of these observed changes, a higher load of canopy, a lower culm strength and a lower uprooting resistance by root system, may be responsible for bamboo lodging observed in the N-saturated site. The results suggest that nitrogen saturation significantly affect morphologies and mechanical properties in bamboo to cause the lodging.

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