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The impact of nitrogen saturation on tree roots, which lead to uprooting

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[Introduction]

Anthropogenic nitrogen deposition has been increasing for these decades (Galloway, 2004). Some adverse effects on plants have been reported, such as root / shoot ratio, severity of disease, plant-fungal relationships (Veresoglou et al., 2012; Gojon et al., 1994; van Diepen et al., 2010 etc.). However, most of these experiments have used herbs or seedlings; there have been few studies that targeted adult trees in forest ecosystems (Meyer et al., 2008 etc.). We investigated a possibility whether adult tree root biomass and physical properties are affected by elevated nitrogen concentration, which enhances uprooting risks.

[Materials and Methods]

Field research was conducted at a nitrogen-saturation site (Tama-hill, Tokyo), a middle N status site (Karibasaka, Saitama), and a nitrogen-limited control site (Ogawa, Ibaraki). Nitrate concentration in a stream for these watersheds was 280, 86, 16 μmol / L, respectively. The sites are deciduous broad-leaf forests with altitudes between 150 ? 650 m and slopes between 22 ? 35 degrees.

Roots and soils of 0 ? 40 cm depth, for konara oak (*Quercus serrata*) and cherry (*Cerasus jamasakura*), were taken 1 m apart from a stand with a core sampler (7.5 cm diameters). Live roots were sorted into two diameter class of $>$2 mm and $<$2 mm and measured for dry weight. Soil nitrate concentrations were measured for water extraction. Wood cores collected from root of these stands with borer auger (5 mm diameters and about 15 cm length) were measured for dry density and Young's modulus (mechanical strength). Angles of stem inclination were measured graphically as an indicator of uprooting risk.

[Results and Discusses]

Dry root weight (both $>$2 mm and $<$2 mm) decreased by 60% with the increase of soil nitrate concentration. Cherry's physical properties didn't show any significant changes with different soil nitrate concentrations. However, core's dry density from konara decreased significantly under higher soil nitrate concentrations ($p<0.01$). Young's modulus was also smaller under higher soil nitrate (more 50 μmol / kg soil) than lower soil nitrate concentration (less 50 μmol / kg soil) ($p<0.05$). Moreover, a part of Konara trees in Tama-hill (N-saturation site) showed distinct stem inclinations as contrast to Ogawa (N-limited site).

The results suggest that nitrogen saturation may have resulted in decreasing root biomass and physical properties to lead to higher uprooting risk.

Keywords: nitrogen saturation, tree root, uprooting