Record and others

Direct negative impacts of nitrogen fertilization on understory vegetation might be ignored in simulated N deposition experiments*1

Taiki Mori*2

Taiki Mori : **Direct negative impacts of nitrogen fertilization on understory vegetation might be ignored in simulated N deposition experiments Kyushu J. For. Res. 73 : 151－152, 2020** An opinion concerning recent discussion about effects of simulated N deposition on forest understory vegetation was presented. Several papers reported that the addition of high concentration of N solution such as NH_4NO_3 reduced understory vegetation, and attributed the results to the plant community shift, intensified N saturation, and reduced light availability. However, the negative impact on understory could be partly because of the fertilizer burn, which was long neglected in the simulated N manipulation experiments. The evaluation of the direct negative impacts of nitrogen fertilization on understory vegetation are strongly required.

Key words：fertilizer burn; nitrogen deposition; plant diversity

Ⅰ. Introduction

For testing the impacts of elevated nitrogen (N) deposition on ecosystems, including the impacts on forest understory, plenty of manipulating experiments have been performed (Gilliam *et al*. 1996 ; Hurd *et al*. 1998 ; Rainey *et al*. 1999 ; Gilliam 2006 ; Bobbink *et al*. 2010), some of which applied high concentration of N solution such as NH_4NO_3 (Nordin *et al*. 1998 ; Rainey *et al*. 1999 ; Schleppi and Edwards 1999 ; Lu *et al*. 2010 ; Tian *et al*. 2017). Among them, several papers reported remarkable negative effects of NH_4NO_3 application on forest understory vegetation, while the effect on large trees was less clear (Rainey *et al*. 1999 ; Lu *et al*. 2010 ; Tian *et al*. 2017). These results have been attributed to the community shift of the vegetation to a "eutrophication-simplified community", the negative impacts of "N-saturation" following Aber *et al*. (1989)'s concept (such as soil acidification or toxicity of active N), and reduced light availability (Aber *et al*. 1989 ; Aerts and Chapin 1999 ; Gilliam 2006 ; Bobbink et al. 2010). In this short paper, I propose another possible interpretation which was ignored in the previous researches that experimentally applied high concentration of N solution.

Ⅱ. Discussion

Nitrogen is one of the most important nutrients for plants, and often applied as a fertilizer in agricultural practices. However, too much usage of the fertilizer can damage or even kill plants, which is known as "fertilizer burn." I suspect that the decline of forest understory vegetation in the several previous researches with experimental application of high-concentration N solution could be due to the fertilizer burn because most of the liquid N used for N manipulation experiment has unnaturally high concentration for eliminating impacts of elevated water input. Since the addition of N are performed to simulate N deposition of rainfall and throughfall, the N solution is usually applied directly on understory leafs (Zhang *et al*. 2015). The high concentration of NH_4NO_3 solution can cause foliar fertilizer damage (Neumann *et al*. 1981), leading to a decrease in understory vegetation.

The NH_4NO_3 solution applied in the N fertilization experiments were up to 0.8 *M*, which could be enough high to cause a fertilizer burn (Rainey *et al*. 1999 ; Lu *et al*. 2010 ; Tian *et al*. 2017). According to Neumann *et al*. (1981) 's experiment, the concentration at which 20 μl droplets of NH_4NO_3 solutions applied to leaf surface began to induce damage was 0.40 *M*. It is likely that high NH_4NO_3 solution can damage forest understory in simulated N deposition experiments.

Considering the possibility of fertilizer burn in the experiment is important because if this is the case, the negative impact of experimental N application on understory may have been over-estimated in several case studies using liquid NH_4NO_3 application. Also, the survived understory may be biased to the tolerant species for high salt solutions. The prediction of the impact of elevated N deposition on understory may be required to be re-considered. The evaluation of the direct negative impacts of nitrogen fertilization on understory leaves, which have been long ignored in simulated N deposition experiments, are strongly required.

*1　森大喜：窒素施肥が森林下層植生に及ぼす影響に関する再考察.
*2　森林総合研究所九州支所　Kyushu Res. Center, For. & Forest Prod. Res. Inst., Kumamoto 860-0862, Japan

References

Aber JD *et al.* (1989) Bioscience 39 : 378–386
Aerts R and Chapin FS (1999) Adv Ecol Res 30 : 1–67
Bobbink R *et al.* (2010) Ecol Appl 20 : 30–59
Gilliam F *et al.* (1996) Can J For Res 26 : 196–205
Gilliam FS (2006) J Ecol 94 : 1176–1191
Hurd TM *et al.* (1998) Can J For Res 807 : 799–807
Lu X *et al.* (2010) Glob Chang Biol 16 : 2688–2700
Neumann *et al.* (1981) Agron J 73 : 979–982
Nordin *et al.* (1998) Funct Ecol 12 : 691–699
Rainey *et al.* (1999) Ecol Appl 9 : 949–957
Schleppi P and Edwards PJ (1999) Phyton (B Aires) 39 : 197–204
Tian D *et al.* (2017) Biogeoscience 3461–3469
Zhang *et al.* (2015) Sci Rep 5 : 11245

（2019 年 10 月 28 日受付；2019 年 12 月 3 日受理）