Geophysical Research Abstracts
Vol. 20, EGU2018-7863, 2018
EGU General Assembly 2018


# Nitrogen nutrition of alpine plants under conditions of long-term fertilizers application

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Nitrogen availability is a major factor regulating plant community structure and limiting plant production in terrestrial ecosystems. We have studied how nitrogen nutrition of alpine plants has changed in conditions of long-term N, P or lime application in alpine soils of different ecosystems which in general are acid, rich in the total N and P, but poor in available inorganic nutrients. The studied ecosystems were represented by low productive alpine lichen heath (ALH) on the most N and P poor soil with lowest acidity; more productive Festuca varia dominated grassland (FVG) and Geranium gymnocaulon/Hedysarum caucasicum dominated meadow (GHM) on the relatively N and P reach soils with higher acidity; and low productive snowbed community (SBC) on the N and P poor soil with highest acidity.

After 20 years of nutrients application some expected changes (twofold increase of ammonium and nitrate N and tenfold increase of available P if respectively N or P were applied, or pH increase if lime was applied) were indicated, while concentrations of the total, extractable organic and microbial biomass C and N, as well as C to N ratios in all these pools and $\delta$15N of total soil N haven't changed.

Change of nutrition conditions has affected on N concentration and $\delta$15N in plant leaves. As expected, the greatest changes were found at N application. Nitrogen concentration has increased in all species except for N2-fixing legumes. $\delta$15N has also increased due to more 15N enriched carbamide compared with soil available N compounds. Additional 15N enrichment of applied N could result from decomposition of carbamide on the soil surface and volatilization of 15N depleted ammonia. These changes were more pronounced in the much more N limited ALH and SBC species.

Other fertilizers have made smaller impact on N status of plant species. Phosphorus application doesn't initiate N2 fixation by Trifolium polyphyllum which doesn't fix nitrogen under natural conditions and decrease N2 fixation by N2-fixing Oxitropis kubanensis. Also phosphorus application in the most P poor ALH soil as well as lime application in the most acidic SBC soil resulted in increase of $\delta$15N in leaves of the majority plant species. Similar change of $\delta$15N under correction of two unfavorable soil properties in two different soils can demonstrate indirect effects on change of plant N nutrition.

This study was supported by Russian Science Foundation (16-14-10208).