2025 Special Seminar on The IDEC Institute

IDEC # 99
PHIS # 46

# Mechanisms of bioavailable CNP release and plant nutrient uptake mediated by fairy ring fungi in temperate steppe


## Abstract

**Fairy rings are unique ecological landscapes caused by basidiomycetes in the global grassland, which affect the growth of aboveground plants to form obvious rings or arcs bands. However, there is still a lack of systematic research to reveal the relationship among bioavailable carbon (C), nitrogen (N), phosphorus (P) concentration and fairy ring fungi. Our study conducted field sampling in five temperate grasslands with abundant fairy rings in Inner Mongolia, China, and collected a total of 35 fairy rings to reveal the mechanism of fairy ring fungi mediating bioavailable CNP release and plant absorption in the soil from microbial perspective. Firstly, we found that the presence of fairy ring fungi significantly enhanced the β-1,4-glucosidase activity and the abundance of C-degradation genes. This promoted the decomposition of particulate organic C and mineral-associated organic C, ultimately decreasing soil organic C by 7.37%. Secondly, the presence of fairy ring fungi promoted the concentration of soil ammonium-N ($NH_4^+$-N) by 455%, through accelerating organic N mineralization indicated by an increase in β-1,4-*N*-acetylglucosaminidase activity. Moreover, higher $NH_4^+$-N stimulated nitrification to enhance nitrate-N concentrations by 130.84%, linked to a greater abundance of *amoA* encoding ammonia-monooxygenase, especially an increase in ammonia-oxidizing archaea. The increased bioavailable N by fairy ring fungi significantly increased plant N content and productivity. Finally, we found that fairy ring fungi not only directly increased plant-available P concentration, but also influenced AMF colonization rates and regulated the abundance of genes involved in inorganic P solubilization and organic P mineralization to promote P uptake by the dominant species of *Leymus chinensis*. In conclusion, fairy ring fungi, as ecosystem engineer species, decompose soil organic matter with their strong mineralization ability, regulate soil microbial community and function, increase the abundance of genes involved in C-, N-, and P-decomposition in soil, thereby increasing the concentration of bioavailable CNP and promoting plant nutrient absorption and utilization.**

**Our results shed light on an enigmatic fairy ring phenomenon in grassland ecosystems, indicating that fairy ring fungi can drive the function of grassland ecosystem and have the potential to be exploited as a beneficial microorganism to promote plant production and sustainable grassland development.**


Date

2025 5/22 Thursday

10:00 ▶11:00

Online

https://00m.in/qHWfc

JOIN NOW

Venue

Hiroshima University, Graduate School of Advanced Science of Matter Build A, 6F Seminar room601-(2)


**Presenter**

**Dr. Yingjun ZHANG**

Professor

Director of College of Grassland Science and technology, China Agricultural University

**Contact**

**Fumito Maruyama, Ph.D.**

**Jianjian Hou, Ph.D.**

**E-mail: fumito@hiroshima-u.ac.jp**

**HP: https://mge.Hiroshima-u.ac.jp/en/**