The environmental and agronomic impacts of γ-PGA on agricultural soils

Jie Li, Lei Zhang\textsuperscript{1,2,3}, Xueming Yang\textsuperscript{3}, Decai Gao\textsuperscript{1,2}, Lingli Wang\textsuperscript{1}, Zhanbo Wei\textsuperscript{1} and Yuanliang Shi\textsuperscript{1}.

\textsuperscript{1}Institute of Applied Ecology, Chinese Academy of Sciences, 72 Wenhua Road, Shenhe District, Shenyang, Liaoning 110016, China (E-mail: jieli@iae.ac.cn); \textsuperscript{2}University of Chinese Academy of Sciences, 19 Yuquan Road, Shijingshan, Beijing 100049, China; \textsuperscript{3}Harrow Research and Development Centre, Agriculture and Agri-Food Canada, 2585 County Road 20, Harrow, Ontario N0R 1G0, Canada

To demonstrate the responses of plant (Pakchoi) and soil to poly-γ-glutamic acid (γ-PGA) is essential to better understand the pathways of the promotional effect of γ-PGA on plant growth. In this study, the effects of γ-PGA on soil nutrient availability, plant nutrient uptake ability, plant metabolism and its distribution in a plant-soil system were tested using labeled γ-PGA synthesized from \textsuperscript{13}C\textsubscript{1}-\textsuperscript{15}N-L-glutamic acid (L-Glu). γ-PGA significantly improved plant uptake of nitrogen (N), phosphorus (P), and potassium (K) and hence increased plant biomass. γ-PGA greatly strengthened the plant nutrient uptake capacity through enhancing both root biomass and activity. γ-PGA affected carbon (C) and N metabolism in plant, which was evidenced with increased soluble sugar contents and decreased nitrate and free amino acids contents. About 26.5\% of the γ-PGA-N uptake during the first 24 h, after γ-PGA application, was in the form of intact organic molecular. At plant harvest, 29.7\% and 59.4\% of γ-PGA-\textsuperscript{15}N was recovered in plant and soil, respectively, with a 5.64\% of plant N nutrition being derived from γ-PGA-N. The improved plant nutrient uptake capacity and soil nutrient availability by γ-PGA may partly explain the promotional effect of γ-PGA, however, the underlying reason may be closely related to L-Glu.