Microbial carbon and nitrogen limitations with mulching of proso millet fields on the Loess Plateau: evidence from soil ecoenzymatic stoichiometry

Hanghang Hou[1,2], Lixin Tian[1,2], Yuchuan Zhang[1,2], Baili Feng[1,2]*

([29]College of Agronomy, Northwest A&F University, Yangling, Shaanxi 712100)

([30]*State Key Laboratory of Crop Stress Biology in Arid Areas, Ministry of Agriculture, Yangling, Shaanxi 712100*)

Abstract:【Objective】Mulching measures can regulate soil properties; however, the effects on metabolic limitations are poorly understood, especially on the Loess Plateau. **【Method】** We conducted field experiments to compare three techniques: flat planting with no mulching (TP), ridge–furrow mulching system (RF), and plastic film mulching (PFM). Soil extracellular enzymatic stoichiometry and physicochemical properties of three growth periods (jointing, flowering, and maturity) of proso millet (Panicum miliaceum L.) were measured to investigate microbial metabolic limitations and the relationship with soil moisture, temperature, and nutrients in three regions of the Loess Plateau (Guyuan city, Huining county, and Yulin city). **【Result】** The results show that compared with TP, PFM and RF techniques increased soil organic carbon (SOC), total nitrogen (TN), ammonium nitrogen (NO_3^--N), and nitrate nitrogen (NH_4^+-N) during the jointing period, but the levels decreased during the flowering period. When compared with TP, the activities of C-, N-, P-acquiring enzymes were 29.02%, 33.68%, and 19.46% when using PFM, and 13.78%, 6.81%, and 6.52% higher when using RF. Compared with TP treatment, RF treatment significantly increased the carbon metabolism limitation during the jointing, flowering and maturity periods of proso millet in the three regions, and also improved the nitrogen metabolism limitation during the jointing and flowering periods of proso millet in the Huining and Yulin regions. Linear regression analysis showed that pH, SOC, and NH_4^+-N contents significantly affected carbon limitation, and nitrogen limitation was gradually alleviated with increases in SOC, TN, and NO_3^--N contents in proso millet farmland soils. Structural equation model showed that soil moisture and nutrients differed significantly among the regions, and soil temperature positively regulated the soil nutrients. Mulching significantly improved the carbon limitation owing to increased soil temperature and moisture. **【Conclusion】** These results provide important ideas for nutrient cycling and microbial metabolism of broomcorn millet farmland soil under mulching measures on the Loess Plateau.

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Hanghang Hou, E-mail：houhanghang@nwafu.edu.cn