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Effects of soil biodiversity on soil multifunctionality after 5-year organic substitutions in a Maize field

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Organic substitution can benefit to enhance soil health and maintain sustainable food production. Soil organisms play important roles in decomposing organic matter, recycling soil nutrients and resisting pests and diseases. However, the effect of soil biodiversity on soil multifunctionality of farmland ecosystem under organic substitution is still unclear. Here, we studied the shifts of soil biotic communities and soil multifunctionality (functions related with C, nutrient cycling and crop yield), and investigated soil biotic diversity-ecosystem function relationship under a 5-year field organic substitution experiment (30% nitrogen fertilizer substitute with straw, cattle manure and biochar, respectively). Our results showed that the highest value of soil multifunctionality was found in straw substitution treatment. Soil nematode community composition significantly associated with soil multifunctionality. We used structural equation modelling to identify the effects of soil biotic diversities and composition on multifunctionality. The SEM model predicted 74% of the variation in soil multifunctionality, and found that nematode community composition directly drove soil multifunctionality, whereas organic substitution and bacterial community composition could indirectly affect soil multifunctionality by changing soil nematode community. Our study has important implications for the contribution of soil biodiversity in driving multifunctionality of farmland ecosystem and for maintaining the sustainable development of agriculture.